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Belgium: Uses of Renewable Ultrathin Iron Foil Outlined

BR0806151293 Rijswijk POLYTECHNISCH WEEKBLAD in Dutch 21 May 93 p 1

[Article by Richard Hovers: "Paper-Thin Iron Foil Solution for Environment; Hoogovens Company Cooperates in Belgian Electrolytic 'Elofoil' Process Rendering Thin Rolling of Iron Foil Superfluous"]

[Text] Tongeren—Cans for beer and soft drinks, food containers which go into the microwave, peel-back lids for yogurt tubs, protection for electromagnetic fields, or honeycomb structures for cars. This is just a glimpse of the market potential for a new, ultrathin but immensely strong iron foil. The process, developed in Belgium and on which [the Netherlands company] Hoogovens has been collaborating, offers great environmental advantages. Iron foil, in contrast to the growing mountain of aluminum tins, is magnetic and therefore simple to recycle. Above all, the basic material for iron foil is renewable: It is scrap metal.

Although the very clever Thomas Edison had already invented the electrolytic process for the fabrication of metal foils at the turn of the century, it was not until the 1960's that electronics manufacturers started to make copper foil by this method. Now the Metallurgical Research Center (CRM) in Belgium is also using the same principle to produce iron foil on an industrial scale via electrolysis. "It has worked," said researcher M. Economopoulos. "We are calling the product Elofoil."

It is remarkable that the Belgians have succeeded in scaling up the electroforming process for iron foil. It so happens that steel producers worldwide have been attempting to make super-thin, semifinished products, but they have invariably been focusing their hopes on complex roll techniques. Economopoulos gave as an important advantage of the electrochemical principle: a very thin product, 10 microns thick, can be made in one processing stage.

Experimental Product Lines

CRM in Tongeren has spent 10 years on the improvement of three important parameters which were needed for large-scale electrolysis aimed at foil production: current density, cathode diameter, and cathode/anode gaps.

Particular to the system are 30 special HTLP (high turbulence/low pressure) anodes surrounding the rotating cathode. The electrolyte only needs to be pumped through these anodes under low pressure, thus reducing the amount of energy needed by the pumps. At the same time, the narrow gap of only two mm ensures sufficient turbulence between the anode and rotating cathode and makes it possible to scale up the diameter of the cathode to a few meters. As a result of these parameter adjustments, the current density—which is essential in the electrolysis process—is at 200 amperes per square decimeter [10 cm x 10 cm].

Pure iron foil is now rolling off the cathode at an experimental production line in Tongeren. The thickness can be adjusted between 10 and 100 microns, and the width is 350 mm. It can be used to fold little aircraft. The test factory's capacity is 8,000 metric tons a year. CRM has attracted three large steel manufacturers for further production development. Hoogovens IJmuiden is to investigate the suitability of the new foil for packaging. Sidmar-Arbed [Belgium] is researching the production of honeycomb structures for the transport sector and building industry. Cockerill-Sambre [Belgium] is taking on the testing of Elofoil as a protective material against electromagnetic radiation.

Not Only Lighter, But Also Stronger

"The news has been received with mixed feelings by the aluminum industry," said Engineer Leo Hartman, divisional manager for packaging technology with Hoogovens. "An aluminum container for food packaging, for instance, requires a minimum thickness of 200 microns. The same container can be made using iron foil with a thickness of 50 microns (0.05 mm), while it is not only lighter but also twice as strong."

The difference in specific gravity between iron and aluminum, a factor of 2.7 to be precise, can be bridged in this way thanks to the iron foil's greater strength in very thin layers.

Peel-back lids can also be made from Elofoil. The advantages for the environment are legion: Fewer raw materials are required per product (decrease of source material); the foil is made from a secondary raw material (scrap metal); the production energy costs are low; and a reduced weight for the end product is attainable. To top it all, there is the immediate significance for recycling thanks to its magnetic qualities.

More Technical Possibilities

According to Hartman, "the present problem is our unfamiliarity with the material; this iron foil contains absolutely no carbon and not a single alloy element. It requires completely new handling and coating techniques. It is all very exciting; technically anything is still feasible, while the possibilities for aluminum are just about exhausted."

Hoogovens, however, still has an iron in the fire; the thin rolling of steel foils is also being very carefully studied. Tests are being conducted on the rolling of ultra-thin, 100-micron packaging steel. "We want to explore what the limits are for electrolysis and rolling, we estimate them to be somewhere around 80 microns. But our rolling mills are absolutely full; an alternative production method for iron foil is very welcome." All in all, it appears that the Belgians have hit the mark.

[Caption to photo; photo not reproduced] Scrap metal is dissolved in a regenerator with the assistance of hydrochloric acid. The electrolyte then flows into a storage tank. From there it circulates through the electroformer, in which a rotating cylinder acts as a cathode. Thirty special HTLP anodes ensure high turbulence with low fluid pressure. The iron particles are precipitated and, after completion of three quarters of the rotational cycle, are carried off as foil.

Netherlands: DSM To Start Mass Production of 'Dendrimers'

BR2906102693 Zellik BELGIAN BUSINESS & INDUSTRIE in Dutch Jul-Aug 93 pp 82-83

[Article by Robert Declerck: "Polymer Chemistry: DSM Looks For Applications for Dendrimers"]

[Text] The Dutch chemical concern DSM is very close to finding industrial applications for dendrimers.

DSM claims to be the first to produce dendrimers in large quantities and at a reasonable price. Dendrimers will, among other things, drastically improve the processing of synthetic fibers.

The term dendrimer is derived from dendrites and polymers. It concerns macromolecules of various kinds, in which various physical and chemical properties (reactivity, shape, size, solubility...) can be controlled by means of synthesis, at will as it were.

The dendrimers are formed from a single nucleus and are then built up further in a step by step process. The large number of branches at the end divide again repeatedly, with a resulting spherical shape. In contrast to conventional macromolecules, therefore, dendrimers are not shaped liked chains but rather like spheres. These polymer globules can also all be made to be the same size.

Dr. Ellen de Brabander-van den Berg, responsible at DSM for the dendrimer project, says: "That is one of the fundamental properties of dendrimers. The layers on the surface of the polymer globule are added step by step. The process is very easy to keep under control. It is far more difficult to control the end product in conventional polymers than in dendrimers."

The possibilities for applications for a product are dependent on its properties. In the case of dendrimers these are: the presence of reactive end groups; the existence of cavities within the molecules; the interrelationship of viscosity and molecular weight; and the possibility of controlling the size of the dendrimer globules (1-10 nanometer).

All kinds of other molecules can be placed in the dendrimer cavities from where they are slowly released again: agricultural chemicals, fragrances, pharmaceutical compounds, etc.

However, that is not the kind of applications which DSM is looking at, because DSM is really a materials and chemicals company. These kinds of application are more suitable for the so-called Tomalia dendrimers, of which only small amounts can be manufactured and because they hydrolyze in the presence of water, with the resulting possibility that they then decompose. This hydrolysis phenomenon has not yet, however, been fully researched.

Usually polymer viscosity grows as their molecular weight increases. That is a hindrance, for instance, to their processability. In dendrimers, however, when an extra layer is added to a specific layer, their intrinsic viscosity decreases.

DSM has not yet provided a clear answer about the applications for the dendrimers it intends to market. "Materials are a possibility which we will look at, but dendrimers are (still) too expensive for a purely materials application. Our first objective is to improve the processability of synthetic fibers without affecting their other properties," says E. de Brabander.

Other possible applications are: improvement of lubricants, improvement of coatings, improvement of resins, use in glues, strengthening of composites, plastics additives, surfactants, etc. DSM is to decide within a very short time what dendrimer applications it will itself develop commercially, and whether it will work toward certain forms of collaboration for other applications.

The DSM dendrimers will come onto the market in the second half of this year. At the moment DSM is producing only a few hundred kilos. Prices will depend on the production volume and on the number of layers (generations) which the dendrimers will have. At the moment price seems to be about the only restriction on the use of dendrimers.

Large-Scale Production

Dendrimers were discovered by Tomalia (Dow Chemicals) in the middle of the 1980's. There were several drawbacks to the Tomalia dendrimers. E. van Brabander again: "They were unstable in water and also at high temperatures, and they could be produced only in small quantities and at a very high cost."

DSM claims to be the first to be able to produce dendrimers in large quantities and at an acceptable price. Above all, DSM's dendrimers are stable in water and in particular can withstand high temperatures, which of course will allow for more application possibilities. Another property of dendrimers is that they have reactive groups at the exterior of the molecules, which easily react with other molecules. Above all, it is also possible to fix other and/or less reactive groups to the exterior of the dendrimer molecules. E. de Brabander again: "One of the extraordinary things about dendrimers is the large number of end groups, which is a notable difference from other polymers. You can choose whether these end groups are reactive or non-reactive. For the DSM dendrimer (which for the time being has no brand name), the end groups are amino or nitrile groups, but these can be changed into other functional groups by means of conventional organic chemistry."

Dendrimers also boast a good thermal stability. This is dependent on the size of the dendrimer globules and on the nature of the end groups. If they are amino groups, then they are more stable at a greater size. This type of dendrimer is thermally stable up to about 400° C.

"In contrast to the synthetic method used by Tomalia, DSM's method offers the possibility of manufacturing dendrimers on a large scale, via a multistep process," said E. de Brabander. DSM feels itself to be in a strong position to attack the dendrimer market. Almost nothing needs to be

invested in processing equipment, because the dendrimers can be produced on existing production installations.

As a result of the publicity which dendrimers have already received, DSM finds itself in a comfortable position; the market is wide-open, as it were. DSM is clear on the question of possible competition over dendrimers: "We have the feeling that we are ahead of everyone in the area of production. We do not see a cheaper synthesis process than ours, which is based on hydrogen and acrylonitrile."

AEROSPACE

DLR's Kroell on Manned Missions: Costs, Benefits, Perspectives

93WS0433A Duesseldorf HANDELSBLATT in German 23/24 Apr 93 p 25

[Article by Josef Hess: "Even the Most Modern Robots Cannot Replace Astronauts;" first paragraph is HB introduction]

[Text] Unless the countdown for the D2 mission is interrupted once again, the U.S. space shuttle Columbia will lift off from Cape Canaveral on 24 April at 1652 hours Central European Time. The two German scientist-astronauts on board will complete an extensive research program. They were largely prepared for their duties at the German Aerospace Research Institute (DLR) in Cologne-Porz. In a conversation with HANDELSBLATT, the chairman of the board of DLR, Professor Walter Kroell, outlined the role of German space flight over the next few years from the aspect of financial bottlenecks. Kroell pleaded emphatically that with all the economy measures one should not gamble with the partnership ability of German space research.

Regarding the repeated launch delays for the D2 mission and, in particular, the last-second aborted takeoff before Columbia's liftoff on 22 March 1993, Prof. Kroell said: "What would have happened if the automatic hold had not occurred, is something there are various expert opinions on. I think that a system such as the U.S. space shuttle must function under the aspect of high safety. Switching off the main engines at the last second, after an engine did not develop thrust, was important and correct and a happy intervention by the computers, before the two additional solid propellant booster rockets had been ignited."

Undoubtedly, the Americans have learned from the Challenger catastrophe in January 1986, he said. The Shuttle system has reached a high level of technical maturity, although the repeated reasons for launch postponements are not exactly proof of technical precision and care.

But to draw the conclusion from the technical mishaps that U.S. space systems are less reliable than Russian ones would be premature, in Kroell's opinion. Nevertheless, he himself is impressed by the precision and safety with which the Russians, more than a year before transporting German astronaut Flade to the space station Mir, indicated the exact date and time of day for the launch and kept to that schedule as well.

The latest launch delay to 24 April is "preliminarily definitive." It has posed certain management problems, "which we have under control, however." Certain experiments had to be brought up to date and samples replaced. To be sure, a few million German marks [DM] in extra expenditure are not very much compared with the entire amount of DM900 million, but in view of the tight financial situation they do of course "hurt."

Regarding the position of the new Federal Research Minister Wissmann on manned space flight, Kroell stated that it has been clear for a long time to all involved that there will be no D3 mission. But he did not understand the minister to mean that he announced a halt to manned space flight. "Astronauts have visions, but they are realists as well." From the change in the economic, financial and political framework conditions for space flight in Germany and Western Europe, one must, among other things, draw the conclusion of still greater international division of labor and costs, he said. International space flight will not only continue unmanned but manned as well, and Germany should participate according to its economic, financial and political as well as cultural importance. This presumes competence and reliability as a partner.

The Germans have already shown competence and, hopefully, they will demonstrate it again with D2. Competence can only be built up slowly and can disappear very quickly when all activities are halted. Reliability presumes that in the long-term business of space flight the political and financial framework conditions do not change significantly in the short term.

At any rate, in the last few years elements of European space flight have repeatedly been canceled: First the so-called Columbus component MTFF, the "Free-Flyer," under German leadership, then the space glider Hermes. And now—essentially for financial reasons—the last remaining major element of manned European space flight activities, namely the docked work module APM, is under discussion. In the future it will perhaps be necessary to give up large, already planned space flight projects, some will be stretched out and others, in turn, postponed. This hurts, to be sure, but is not catastrophic. Despite recognition of other priorities (financing German unity), a change in political acceptance and financial ability, we Germans must retain our competence and reliability and thus our capability of acting as international partners. For Kroell it is a question of fundamental or even crucial importance "whether in 5, 20 or 100 years we will head for Mars." But he does not doubt that in the future people will take off again "in order to push the limits of spiritual and physical existence into space as well," as was the case in 1969 with the first landing on the moon.

Despite all the need for saving, the Europeans must keep as one of the first priorities their own access to space by means of the Ariane booster, which is also very successful commercially. The question of whether the development of robotics and automation has already gone far enough to replace the tasks of manned space flight with unmanned, is answered by Kroell with an unequivocal "no." Although a DLR-developed robot with high sensory intelligence is

flying for the first time on the D2 mission, the capabilities of this "world's best equipment" for replacing human action in space is still very limited. The so-called Rotex experiment makes it clear, however, that in this field there is still a huge development potential with fascinating prospects.

Kroell admits that in the past research under the conditions of microgravity (near-weightlessness) was overvalued. But at present the danger exists that the baby could be thrown out with the bath water and microgravity research be rated too low. The Americans and Japanese are accelerating their activities in this field and planning additional space missions utilizing the German Spacelab development, he said. No one can guarantee today that this research will bring major scientific or even economic success. But the opposite cannot be proved either. For this reason one should continue to give this research a chance.

For the period after D2, the chief of DLR pleads for an E1 mission within the framework of the European Space Agency, ESA, in which one should contemplate whether there should be participation with the Japanese, for example. This makes a great deal of sense, because in the short term the additional missions to the Russian space station Mir, which right now are planned within the ESA framework, are realizable and financially manageable, since the German Mir mission has cost less than DM50 million. But the cooperation with the Russians should not primarily be used to take advantage of Russia's difficult financial situation. On the contrary; the Russian space flight infrastructure, established at great expense, should be used in a partnership manner in order to contribute, as much as we are able, to maintaining Russian know-how and Russian capabilities in space for the next few years.

The DLR chairman rejects the occasional impression by the public that his organization is "the great money guzzler for manned space flight." Although the DLR with its 4,200 employees and an annual budget of more than DM700 million is the largest engineering research facility in the FRG, with principal locations at Cologne-Porz, Stuttgart, Oberpfaffenhofen, Goettingen, Braunschweig and Berlin-Adlershof (the former GDR institute for Cosmos Research), and, further, with a rocket test center at Lampoldshausen, an antenna field at Weilheim and a satellite receiving station at Neustrelitz/Mecklenburg, of the overall budget only 60 percent, out of more than DM400 million, is for space flight. Less than half of these DM400 million, that is to say DM160 million, can be shown to be institutional support for space flight by the Federal Government and the laender; the other half are funds which were solicited from ESA programs and projects and other international satellite organizations, for example. But indirectly the ESA funds are also public money, of course.

Kroell stresses that only about one-third of the spending for German space flight activities can be shown to be for manned space flight. And besides space flight there is a wealth of research activities by the DLR in aeronautics and energy technology, such as:

- Development of the recent Compas landing system for aircraft
- Construction and operation of the solar power test field in Almeria/southern Spain
- Flight simulators such as the Attas test-support aircraft, developed from the two-engine VFW 614
- Development of facilities to test active control of helicopter rotors
- Design, together with MTU [Motoren- und Turbinen-Union GmbH], of the CRISP engine, which makes do with 20 percent less fuel than today's engines
- The Saenger hypersonic project was abolished, to be sure, but the hypersonic technology program continues
- Together with France, Great Britain and the Netherlands, construction and operation of the European Transsonic Wind Tunnel (ETW) at Cologne-Porz
- In the field of energy technology, research to optimize gas and oil consumption
- Development of solar and wind facilities
- Studies of extraction and utilization of hydrogen as a secondary energy carrier
- Design and application of high-energy laser sources.

The DLR is particularly proud of individual developments which have met with the highest international recognition. Among them are, for example, a new type of camera system for an unmanned Russian mission to Mars, with which we "will bring high-resolution stereo and color pictures from the surface of Mars down to earth, using the most highly developed, modern, leading technology worldwide."

Kroell counters society's general criticism of space flight with an example: In the 15th century, China was the undisputed leading nation culturally and technologically in the world. At the time China's maritime fleet went on exploration voyages as far as Africa. The Ming dynasty at that time had enormous problems at home. This caused it to order back the fleet and burn it, in order to put an end to the costly adventures on the distant shores. "They did not know that at the same time Columbus set out from Spain to discover a new world."

Kroell does not doubt that the goals will remain open for manned space flight as well. Although one must ease off in space flight over the next few years, one should instead emphasize direct useful application such as telecommunications, earth observation and weather forecasts. In the long run, however, the human race will start developing "habitats" (living spaces for humans) in space or on the moon or try to get to the planet Mars and back.

To the reference that German rocket pioneer and the "father" of the U.S. moon rocket Saturn 5, Wernher von Braun, in 1972 in a conversation with HANDELSBLATT considered a manned Mars to be technically feasible by the year 1985 "if the survival of humanity depends on it," the DLR chief was more cautious. He does not believe in the Mars mission demanded by the U.S. president by 2019, the 50th anniversary of the U.S. landing on the moon, "not because it could not be technically done in this period of time, but because the resources are not available."

Regarding the criticism of the costs of major research in general, the DLR chief said that with the keen worldwide competition in the field of research and technology, activities with major, concentrated funding must continually be conducted over a longer period of time. In certain fields, in which it was not possible to anticipate marketing for the foreseeable future, this research should also be financed with public funds in the interest of caring for the general public welfare. In this category belong, for instance, parts of environmental research, medical research and questions of future energy supply, matters such as solar energy and hydrogen technology. Here one should attack the problems in a long-term way but without false promise—such as a quick solution to the energy problem.

Politics, as well as the media, should aim its actions toward "the reestablishment of a broad public consensus about the importance of research and technology for the future of this country." In other countries of the world there are mechanisms by which a long-term supporting consensus can be created, for example in Japan. In France as well there is a national consensus, independent of political parties, for instance in the field of space flight. Unfortunately, we Germans tend to decide something, but then again to question it in academic dispute and even to talk it to death.

For the D2 mission, for example, it has constantly been calculated how much a second in space costs the German taxpayer. But it is also possible to set up another calculation: The D2 was prepared over the space of eight years. The full costs for the FRG are about DM750 million, or less than DM100 million a year. This means that during these eight years every FRG citizen would only need to give up a glass of Koelsch [beer] or half a pack of cigarettes in order to come up with this amount.

In Kroell's opinion, it is not sufficiently clear to the German public that only thanks to the lead in research and technology can the standard of living for everyone in the high-wage country of Germany be assured. Furthermore, the catching-up time for competitors with lower production costs is getting increasingly shorter.

One of the new federal research minister's basic positions can only be emphasized: This country has outstanding, internationally competitive research and a strong economy. But we have to reflect on how we—perhaps with new instruments—can improve the interactive relationship between science and business and industry in order faster than before to be able to transfer scientific achievements to new marketable, innovative products and methods.

In a country such as Japan, which in the past spent only a fraction of the amount the FRG did for basic research, this conversion process has been effectively, efficiently and outstandingly organized. Even with foreign knowledge the Japanese have very quickly brought out new products and opened up new markets. Cooperation between major research and business and industry in Germany has occasionally been pilloried as public aid for private enterprises. The critics ignored the fact that our country is not able to set the framework conditions of international competition onesidedly.

The other competitors—this is quite clear in the aviation industry—massively safeguarded their own industry with public funding through research and technology subsidies, and, furthermore, with the corresponding acceptance from their own citizens. "After all, the situation is not such that today you can deliver a basic research achievement to industry and say, here, as of tomorrow you can use it to make another product." All the important technological innovations—even industrial ones—of the last 50 years took 20 to 30 years from recognizing the physical phenomenon to application. With such a lead time, the government must provide early financing before application, because an industry oriented toward market-economy is not able to do this until it knows whether it will ever do business with it or not.

German Hypersonics Technology Program and SANGER

93WS0442A Nagoya PROCEEDINGS OF INTERNATIONAL AEROSPACE SYMPOSIUM '92 in English pp 110-116

[Article by Helmuth Hauck and Heribert Kuczera, Deutsche Aerospace AG, Germany]

[Text]

Overview

Today spaceflight is based primarily on conventional vertically launched transportation systems that are not or only partially reusable. Although these systems represent reliable means of space transportation, the costs of delivering payloads into earth orbits are still too high. Consequently, worldwide efforts aim to develop concepts for completely reusable space transportation systems using airbreathing engines, that are capable of taking off and landing like airplanes.

As early as 1988 the German Federal Ministry for Research and Technology (BMFT) laid the foundation for a major investment into the future of space transport by creating the Hypersonics Technology Program based on the Sanger reference concept. The current Phase I of the program is continuing till the end of 1992. An extension of Phase I until 1995 is being planned. During these additional three years emphasis will be put on increasing international collaboration as well as supporting the creation of a dedicated ESA technology program. The main goal is to establish a well-founded technological basis for the next generation of space transportation systems. Of particular importance is the definition of a comprehensive technology verification concept including the implementation of an appropriate hypersonic experimental vehicle.

The aim of this paper is to delineate the present status of the program. The following topics will be covered: Overall hypersonics technology program, status of the Sanger reference concept, alternatives for a flight test vehicle, status of technological activities in the area of airbreathing

propulsion as well as aerothermodynamics and propulsion integration, materials and structures. Finally programmatics are covered together with an outlook on future plans under discussion today.

1. Introduction

The Sanger concept, named after the German space pioneer Prof. Eugen Sanger (1905-1964), is a manned two-stage winged space transportation system (Figure 1), which will also be capable to operate from European airfields. The first stage consists of a hypersonic carrier aircraft, which is propelled by turbo/ramjet engines using liquid hydrogen. The separation of both stages occurs at an altitude of app. 40 km at a speed of Mach 6.6. The first stage flies back to its starting point, the second stage climbs to the selected orbit using its own rocket propulsion and, after having fulfilled its mission, glides back to the ground, possibly to Europe. This requires a cross range cruise capability of app. 3000 km.

The second stage is designed around a "standard payload requirement" with a volume of 4.6 m^{φ} x 7 m and a mass of 7 tons. Two versions of the second stage are foreseen, each tailored to a specific mission requirement: A manned version will carry three astronauts and will be able to transport up to 3 tons of payload to a space station; an unmanned version—being identical in its external configuration with the manned version—will transport up to 7 tons into a space station orbit, having also the capability to retrieve relevant payloads (e.g. reusable platforms like ASTROSPAS, Eureca, SPAS).

Sanger is still in its conceptual phase, it is not yet a project. As reference concept it is easily and flexibly adaptable to changing requirements. In its role as reference concept for the program it acts as focal point for all activities and governs all technology developments.

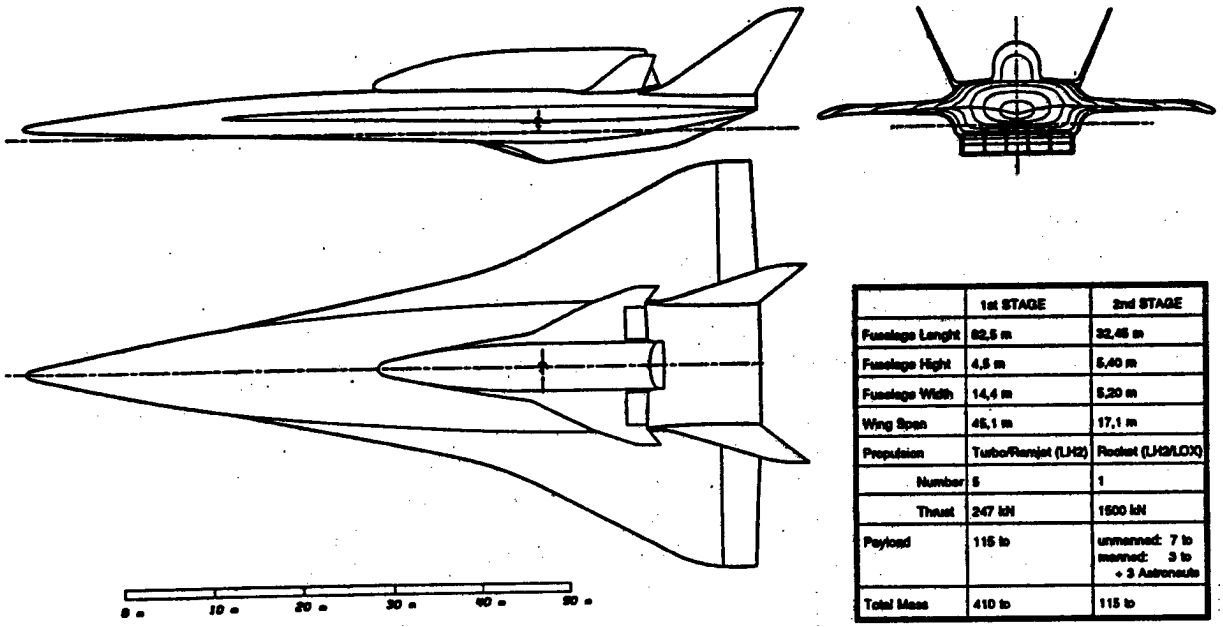
2. Program Status

The Hypersonics Technology Program, which was initiated in 1988 by the German Federal Ministry for Research and Technology (BMFT), has consistently been planned to be conducted in several consecutive phases.[1] The current Phase I is funded till the end of 1992 and will be extended by three years until 1995. This extension phase will be dedicated to improve the technological basis in order to provide the major prerequisites for entering into Phase II which will have to concentrate on further technology improvement, maturation and verification.

The progress of this program has been reported annually.[2-7] The subsequent chapters 3 and 4 will describe major achievements of the last year. It can be recognized that, after some years of basic technology developments, significant progress has been made concerning the major component technologies and their verification by ground tests.

The developed technologies are applicable to a wide range of potential future space transportation systems. The availability and continuous improvement of a reference concept implies that all technological activities are well-oriented and coordinated. This prevents the development of technologies for their own sake or even for stock. But this does not exclude the consideration and in-depth investigation of alternatives and of growth potentials.

The development and implementation of an advanced space transportation system will in general not be feasible



	1st STAGE	2nd STAGE
Fuselage Lenght	82,5 m	32,46 m
Fuselage Hight	4,5 m	5,40 m
Fuselage Width	14,4 m	5,20 m
Wing Span	45,1 m	17,1 m
Propulsion	Turbo/Ramjet (LH2)	Rocket (LH2/LOX)
Number	5	1
Thrust	247 kN	1500 kN
Payload	115 to	unmanned: 7 to manned: 3 to + 3 Astronauts
Total Mass	410 to	115 to

Figure 1

within a national effort. Therefore, international collaboration is mandatory and has to be prepared well in advance. Scenarios have to be established—including global aspects—and requirements must be defined jointly. Alternative concepts (e.g. TSTO vs. SSTO, subsonic vs. hypersonic first stages etc.) have to be examined with regard to their technological requirements and, as a consequence, their feasibility within certain time frames. Near, medium and long term concepts will look different and have to be based on different technological assumptions as well. Currently, a lack of differentiation in this respect has to be conceded. Future international cooperative efforts should concentrate on establishing a mutual understanding of major aspects. Collaborative technology developments need this kind of basic consensus. In order to provide this basis, bilateral or multilateral consultations have to be initiated at the earliest date.

Within the German program continuous international consultations have been held and significant agreement has been achieved. These efforts have to be continued during the next few years in order to prepare the initiation of a joint Hypersonics Technology Program. The first phase of such a joint program has to be dedicated to technology improvement and maturation as well as related validation and verification. Of particular importance is the availability of appropriate test facilities for ground tests and also flight tests. A major milestone in this phase will therefore be the definition, development and implementation of a hypersonics experimental vehicle for use as a flying testbed.

The European Space Agency (ESA) recently has proposed to set up a program in 1993 with the objective of conducting studies and developing technologies for future space transport systems. This initiative should lead to an agreed joint program which, from a German point of view, also should provide the basis for all Phase II activities within a comprehensive ESA program.

3. Reference Concept Update

The 1991 Status Report[6] described the reasons why the unmanned cargo upper stage concept had to be changed. Subsequently the configuration, layout and the structural concept of the twin upper stages (manned and unmanned versions) had to be re-worked. As a consequence of the size and mass increase of the upper stages, the first stage also had to undergo some modifications with respect to configuration, thrust performance and upper stage integration. These modifications are still underway and will yield a consistent layout of both stages until the end of 1992.

The current study activities comprise detailed structural investigations for both stages. For the two large integral cryogenic LH_2-tanks of the first stage two different structural concepts are being investigated. Actually, the front tank is a sandwich construction with CFRP facesheets and an internal CFRP stiffening structure. The rear tank within the wing section is foreseen to be a CFRP shell construction with an internal insulation. More details are given in chapter 4.

The front and rear cryogenic tanks of the second stage most probably will consist of CFRP shells with internal insulation like the first stage rear tank.

Several other important study tasks are in progress, most of which should not lead to significant modifications of the reference concept. They will mainly confirm or iterate earlier made assumptions. A major study task consists of the optimization of the flight trajectory of the first stage.

Further iterations and optimizations are being performed taking into account the results of the propulsion integration design with regard to trim, stability, controllability etc. Detailed trajectory calculations show, that for an optimized ascent from Europe (e.g. latitude 48° N) to a 28.5° inclined orbit the necessary cruise phase is of less influence than anticipated earlier. Of a total ground track length of 2500 km only 35 percent is taken by the cruise phase, consuming approx. 25 percent of the fuel. On the basis of a global scenario other relevant launch sites will be considered too. In addition, ferry flight trajectories (from Europe to Kourou) have been calculated.

Until the end of 1992 the results of all study activities will be put together and will yield a comprehensive updated set of reference data for the Sanger concept. Up till now all activities within the Hypersonics Technology Program have proven the validity of the Sanger concept.

4. Technology Development Status

Within the German Hypersonics Technology Program three major key technology areas are pursued:

- airbreathing propulsion
- aerothermodynamics and propulsion integration
- materials and structures

A detailed definition of the individual efforts was given in Ref. 6. The intention of this section is to highlight major achievements and to describe briefly the related illustrations.

Airbreathing Propulsion

After broad developments of basic technology at the start of the program significant progress has been made in the development of component technology and in related ground tests.

A Ram combustor with active hydrogen cooling has been tested extensively up to Mach 5. It is built of bundled thin wall tubes which provide the cooling function. An electroplated metallic jacket gives sufficient pressure load capability. By the end of 1992 the improved test facility at Ottobrunn will provide the test conditions for Mach 7 simulations.

Several Ramjet flameholder arrangements were built and investigated. In particular circular guide vanes look promising with integrated hydrogen injectors and "shark teeth" shaped flameholders. This experimental arrangement is the result of a successful cooperation with VOLVO/ Sweden within the program.

By the end of 1992 a combined test of the Ram combustor with an integrated nozzle and an expansion ramp will be performed. For this Mach 7 simulation an instrumented 2-D test nozzle has been built and successfully tested at the new test facility of DLR in Koln.

The expansion ramp is built of carbon/carbon. During the test of the whole combination gas temperatures of approx. 2800 K will be reached.

Aerothermodynamics and Propulsion Integration

As part of the program approximative computational methods and numerical tools (CFD) have been developed and improved; complementary wind tunnel tests were performed. Some activities were specifically tailored to the configuration of the Sanger reference concept. As one example out of a wide variety of applications the inviscid pressure distribution of transonic speed is mentioned here. The prediction of drag in the transonic regime is of high importance for the definition of thrust requirements and of the resulting acceleration.

A most interesting comparison of stage separation measurements with theoretical predictions was made, both referring to exactly the same initial conditions. Schlieren photographs were compared with inviscid 3-D solutions and viscous 3-D solutions for a stage separation speed of Mach 6. The wind tunnel measurements were performed at the hypersonic facility of DLR at Koln with a 1:160 scale model (true model length: 57 cm).

A generic hypersonic model intake has been built with a cross section of approx. 10 cm x 10 cm. This model has the advantage of adjustable side walls for boundary layer influence investigations. In addition it is moveable towards the wind tunnel walls for further boundary layer variations.

Materials and Structures

In the current phase of the technology program several representative structural components have been designed, built and tested. Among them are a wing leading edge structure fabricated of preformed titanium alloy sheet metal. This technology will be primarily applicable to fuselage structure at elevated temperature levels.

A highly efficient metallic thermal protection system has been developed and thermally tested with impinging hot rocket motor exhaust gases. This technology has a great potential for re-entry vehicles. The metallic multiwall concept with internal insulation is able to sustain high temperature loads at reasonable ratios of mass per area.

The current cryogenic tank concepts already have been mentioned in chapter 2. The first one is an integral concept using evacuated sandwich walls with CFRP face-sheets and internal CFRP stiffeners. The alternative concept is based on CFRP shells with internal insulations. Both concepts are being investigated and first cryogenic tests will follow within the next months. In a subsequent phase large panels will have to be tested in a thermomechanical test facility.

A CMC component which is representative for high temperatures has been fabricated and will be tested. It is a high temperature air intake ramp made of C/SiC material. Thermomechanical tests will be conducted by the end of 1992.

All these technology developments for materials and structures will deliver important contributions to the overall structural concept of the first stage of Sanger.

In the above-mentioned technology areas manifold test results are already available and additional ones will be obtained in the near future. All results are used to examine the assumptions which were made for the reference concept and to check its validity.

Further technology verification tests will be performed in the subsequent phase with increasing degree of integration. A major test objective for the near-term future will be the test of an integrated model propulsion system including intake, engine(s), nozzle and expansion ramp. All ground tests will be conducted with hardware that is designed and fabricated in near flight quality.

5. Technology Verification Aspects

All technologies must be tested and verified in ground tests and in flight tests. Financial limitations require full exploitation of ground test facilities wherever possible. Only in those cases where ground tests are irrelevant or not feasible, the technologies and components have to be tested and verified in actual flight tests.

Besides an extensive screening of internationally available ground based test facilities different concepts for appropriate flight test vehicles have been investigated. The major vehicle alternatives range from manned hypersonic test aircraft to unmanned test vehicles.

Both the technical as well as the financial feasibility have to be proven before a selection can be made. Many aspects have to be considered and realistic cooperation strategies have to be established. Different scenarios require a detailed examination, e.g. one demonstrator with high test flexibility or even modularity versus a stepwise approach with dedicated vehicles for limited purposes.

The selection of a flight test vehicle has to be based on detailed technological and financial analyses. The definition of the test objective in conjunction with a related ground test program are mandatory prerequisites. Within the German Hypersonics Program first steps have already been undertaken towards the definition of a broad technology verification concept. Further steps will follow with the inclusion of available foreign ground test facilities. It will also be investigated to which extent growth potentials like SCRAM propulsion can be taken into account. It is the major goal of the envisaged extension phase to evaluate various vehicle concepts and to prepare the selection of the most suitable one on a collaborative basis.

6. Programmatic Aspects

The current Phase I of the German Hypersonics Technology Program is funded till the end of 1992. It will be

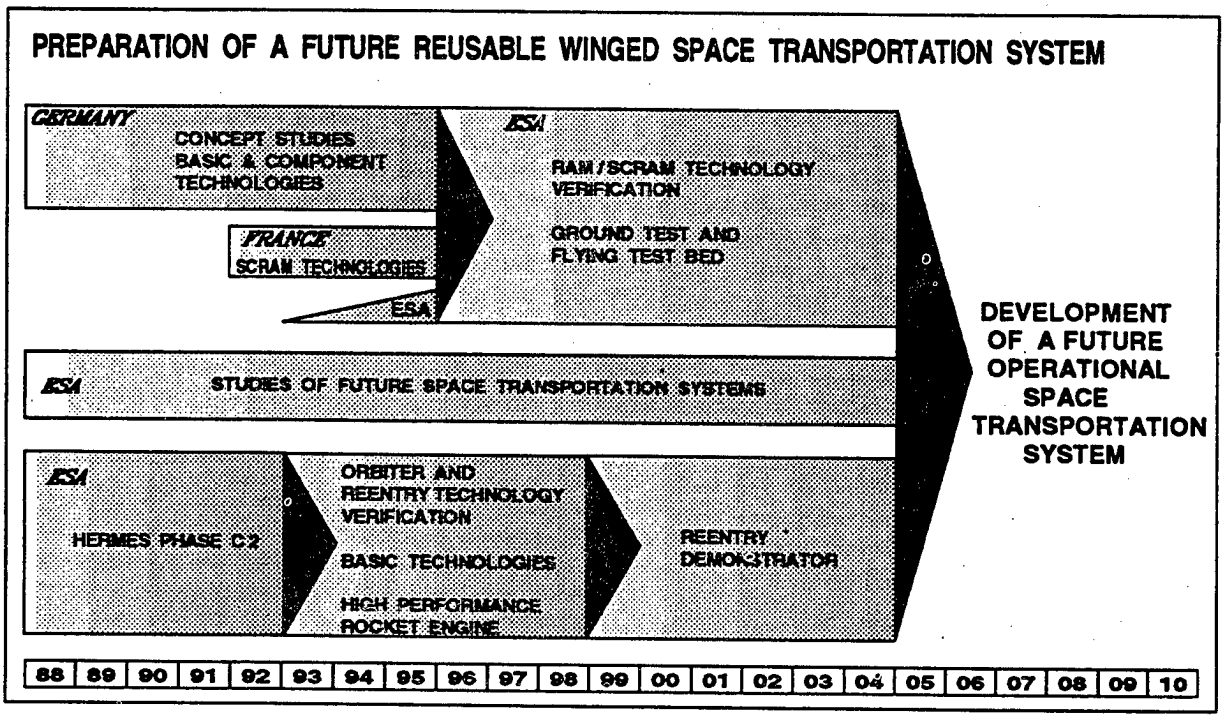


Figure 2

extended until 1995. This extension phase will be dedicated to continuing and maturing technology developments in order to provide the technological basis for entering into the next program phase. Instead of conducting this subsequent phase as a national program with international cooperation it is foreseen as a joint ESA program with additional international participation. This programmatic approach is illustrated in Figure 2.

—ESA is planning to start a future space transportation technology program in 1993 with modest but continuously growing annual budgets. It is expected that this ESA activity together with the German and French national programs will later merge into one comprehensive joint program. Figure 2 indicates two additional activities of ESA.

—In order to prepare a collaborative decision on the specific kind of a future space transportation system all relevant concepts will have to be examined. As part of the ESA program comparative studies and analyses have to be continued. Special attention has to be devoted to the definition of a realistic time frame, based not only on future requirements but also on the availability of certain technologies. This conceptual work should lead finally to a basic consensus about common objectives and to the selection of an appropriate reference concept.

—Up-to-date the Hypersonics activities are concentrated on first stage technologies and on airbreathing propulsion. Technologies for the upper stages and for re-entry have to be developed and matured in a complementary program. A potential solution is shown in Figure 2. After the current changes within the HERMES program alternative ways are under discussion. A technology program for an orbiter and for re-entry should get the highest priority. It should contain all major technologies relevant to an advance orbiter, among them the high-performance rocket technology and advanced materials and structures. Analogous to the Hypersonics program a consequent technology verification concept, including appropriate flight tests, has to be established.

For these parallel activities an agreement between all partners has to be reached. It will lead to the preparation of a consistent technological basis for the development of a future operational space transportation system.

7. Conclusion

The German Hypersonics Technology Program is approaching the initially planned end of its Phase I. An extension phase will be undertaken until end of 1995. During these additional three years further developments and maturation of technologies will be performed in order to provide an adequate technology basis for a subsequent program phase, which is planned to be conducted as an ESA program.

This extension phase also has to be used for further increasing international cooperation and for achieving a common understanding of objectives, requirements and feasibilities of envisaged concepts. A joint program seems to be the only way to realise a future operational space transport system. Within ESA first steps are being undertaken now towards the creation of a program for future space transport technology, which could begin already in

1993. It is expected, that these ESA activities and the national programs in Germany and France will later merge into one joint technology program with a comprehensive international participation.

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A French Look at the Future Supersonic Transport

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[Article by Ph. Poisson-Quinton, honorary senior advisor, ONERA, vice president, ANAE]

[Text]

I. Introduction

In November 1989, more than 200 specialists from all aeronautical countries met in Strasbourg on the initiative of the Academie Nationale de l'Air et de l'Espace (ANAE). They exchanged their views on the future of supersonic and hypersonic air transportation systems.[1] On many questions, a real consensus was reached, other questions were more controversial.

After this symposium, ANAE has pursued its own reflection[2]: looking ahead to the next 20 years, the following major conclusions have been drawn:

1. Towards the beginning of the 21st century, the potential market will be sufficient to justify the launching and introduction of a new supersonic transport (carrying about 250 passengers over some 6,500 nautical miles).

2. The technical feasibility of an aircraft meeting the various constraints known today and cruising at Mach 2.2 or less is established, even if considerable work has still to be done before any launching. A much higher speed can be considered but not yet justified by its cost/effectiveness.

3. Feasibility depends in a critical way on conditions related to environment: a better knowledge on a possible stratospheric pollution, and long term worldwide policy on noise level around airports must be ensured prior to any launching. A large international consensus must be obtained on these subjects.

4. Research programmes should be launched or continued and certain testing facilities developed, not only to confirm the feasibility of an initial project but also to possibly ensure the perennity of this family of transport aircraft through progressive improvement.

5. The experience gained from the Concorde programme has been highly positive for French/British manufacturers and scientists, during 10 tough years of research/development in the 60's and nearly 20 years of airline service; this unique experience must be used for participating to the development of a single supersonic transport that is acceptable to the community and operationally viable for all major airlines.

A great number of reports have been recently published[3-7] on economical and technical aspects of a future supersonic transport. The present paper is limited to a short survey of the main technical problems already solved during the Concorde programme and those to be solved before launching a future SST; to illustrate such objectives, the main characteristics and the expected performances of the Aerospatiale Alliance project are analysed with those of various advanced SST engines studied by SNECMA. Finally, reference is given to the quite similar views of British Aerospace and Rolls-Royce, relative to their own projects.

II. Market and Performance Requirements

Most of the experts predict a strong long range traffic growth during the next decades (Figure 1a), and mainly in the Pacific Rim (Figure 1b); this traffic must induce an important market turnover (Figure 1c), split between the new generation of large subsonic airplanes (60 percent) and the new SST (40 percent) when looking at the expected period of their production (2005-2025); 500 to 1000 SST are expected in 2025 (Figure 1d), depending upon the world economy, but also on the ticket fare premium requested to fly supersonic, here between 15 and 30 percent, see Ref. 4.

This long range traffic around the world is perfectly illustrated by H. Mizuno[1] on Figure 2, mainly along three branches: Transpacific, Transatlantic and Transiberian, the "world business triangle." This map shows that a large part (more than 70 percent) of the main routes are flown above water and quasi-desertic area: in that case, it seems possible to negotiate formal agreements to tolerate the SST cruise boom; in every case, the strong "super booms" generated during their transonic acceleration must be concentrated above well-defined zones above water or desert, as shown in Figure 2.

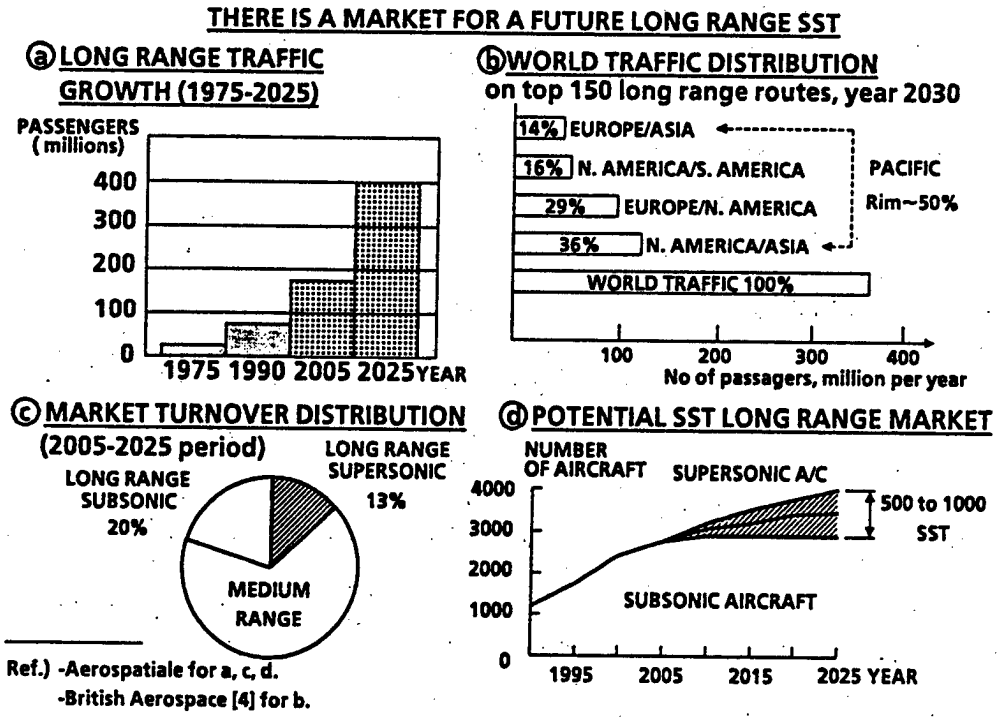


Figure 1

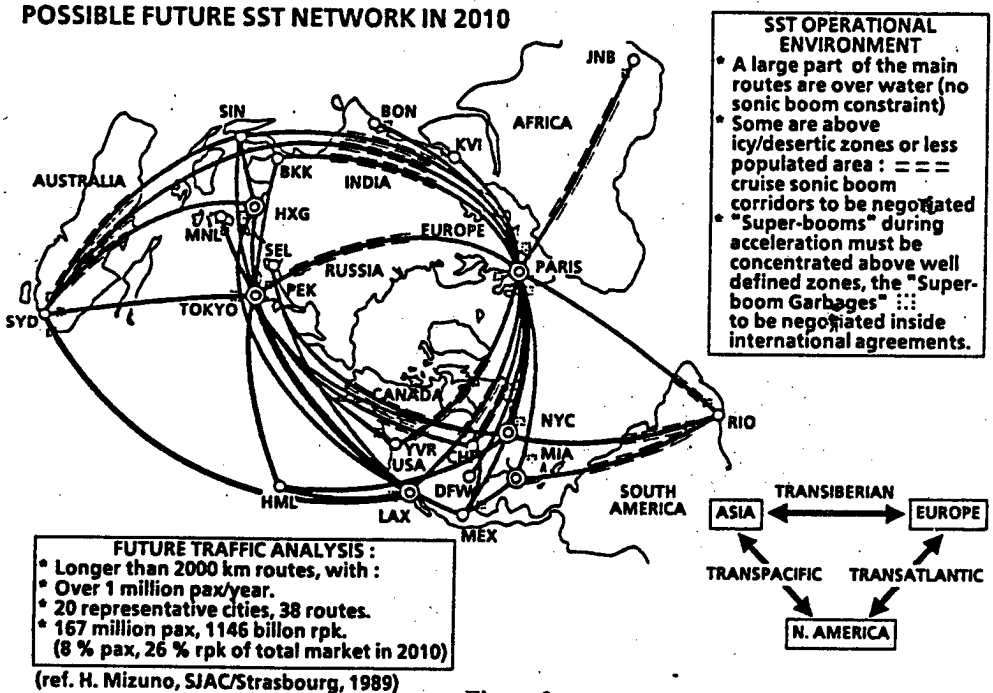


Figure 2

The most important choices for a future SST are its range and its speed[8]: during the Strasbourg symposium,[1] the major airlines have agreed on several requirements:

- Range up to 6500 nm and not below 5500 nm.
- Cruise speed between Mach 2+ and 3, reducing the block time by more than 50 percent compared to subsonic airplanes.
- Capacity: 250 seats or more.

In Figure 3, the block time versus the cruise Mach number is given for two typical long range flights representative of Transatlantic (3200 nm) and Transpacific (6500 nm) segments, taking into account the times for taxiing and climb/descent: above Mach 2+, the time saving is less and less interesting with increasing Mach number, whereas the technical and operating problems are more and more severe. That is why all the recent projects are now designed around Mach 2+ to 2.4, satisfying the request for more than 50 percent time saving when there is no sonic boom constraint: even at Mach 2+ it is shown in Figure 4 that on three major routes between Tokyo, London and New York, this time-saving exceeds 50 percent for direct flights along a great circle route.

But, to avoid sonic boom on populated area, it is possible to choose a detour or even to fly subsonic: in Figure 4, it is shown that both the block time and the direct operating cost are severely increased, except if the sonic boom is allowed over scarcely inhabited areas.

III. From Concorde Experience to New Technological Approaches

The present status of Concorde experience, given in Figure 5 [not reproduced], is quite impressive, and it is interesting to review some of the technical spin-offs of this programme,[13] summarized in Figure 6 [not reproduced], and their usefulness for a future SST.

On the negative side, two major reasons of Concorde commercial failure were its too small range and its noise around airports; that is why the Concorde manufacturers had proposed in 1976 (the year of its introduction on airlines) an improved version shown on Figure 7 [not reproduced]; much better aerodynamic performances were expected from a span extension and addition of leading-edge flap; decreasing fuel consumption and noise were also planned thanks to engine and nozzle improvements; but it was too late and too expensive to be launched.

The choice of the Concorde wing shape was the result of very long research on slender wings in France and in UK[9,10,13]: at low speed, this slender shape generates a strong organized vortex flow giving a large lift improvement at high angles of attack, as shown in Figure 8 [not reproduced]; this vortex lift, added to very positive ground effect with this slender wing, was mandatory to obtain not too high the speed for the take-off and landing phases. But this favourable vortex lift had to be paid by more induced drag, i.e. more thrust inducing more noise.

During the Concorde development—and since then—a great number of leading-edge configurations have been studied, summarized in Figure 9 [not reproduced], to improve both the lift at high angles of attack and the aerodynamic efficiency; but these two objectives are incompatible with a simple leading-edge flap, deflected up and down respectively.

The best compromise for a future SST will be probably a "Kruger" vortex flap (developed by NASA), also compatible with a future laminar suction control, illustrated on Figure 16 [not reproduced]. It seems that this hybrid laminar flow control at supersonic cruise is certainly one of most exciting subject for future research; NASA and Boeing studies[11] have already shown that a large friction drag reduction seems possible, inducing perhaps more than 10 percent fuel burn reduction on a long range mission; even if this concept is not applicable before long flight validation, it would be possible to apply the SLFC on a derivative by a limited modification of the wing leading-edge area, and a planned pumping system installation.

Another way to reduce the friction drag at supersonic regime would be the application of "riblets" tape[12] on airframe surfaces, acting on the turbulent boundary layer; recent basic tests at ONERA on a cylinder are encouraging, as shown on Figure 11 [not reproduced].

For the wing aerodynamic optimization, sophisticated computational methods are already available for all the Mach domain; Figure 12 [not reproduced] gives one example of a Euler calculation on an Aerospatiale wing shape for the three major regimes: supersonic and transonic cruise and low speed (which includes the vortex flow pattern); the experimental constant-pressure and total forces allow a good validation of this theoretical approach. The crucial importance of an accurate drag prediction at the preliminary design stage is examplified in Figure 13 [not reproduced], where the three drag values at Mach 2 are shown: calculated pressure drag, calculated friction drag (wind-tunnel Reynolds number) and experimental total drag; it is shown that the Reynolds number correction to be applied for the flight value is of the same order of magnitude as the equivalent full payload! Thus, it is most important to have a precise validation of friction drag calculation with good flight experience: an operational Concorde has been recently used for such a full-scale validation, as shown in Figure 14 [not reproduced].

At supersonic cruise, friction means severe kinetic heating: with the Concorde programme (Figure 15 [not reproduced]), we have learned a lot on thermo-elastic structural problems, which have required 10 years ground testing on a full-scale airframe, but also requested careful maintenance in operation.

Even at a moderate Mach 2 cruise, this warm environment induces severe problems on the various equipments and mainly on the air conditioning system, able to cool external air from 127°C stagnation temperature to 21° for the passengers (see Figure 17 [not reproduced] and Ref. 13).

Instead of aluminum alloy used for the Concorde airframe, Aerospatiale will choose, for the Alliance airframe (Figure 16) several advanced materials: titanium for the main wing box, light alloy for the fuselage and various types of

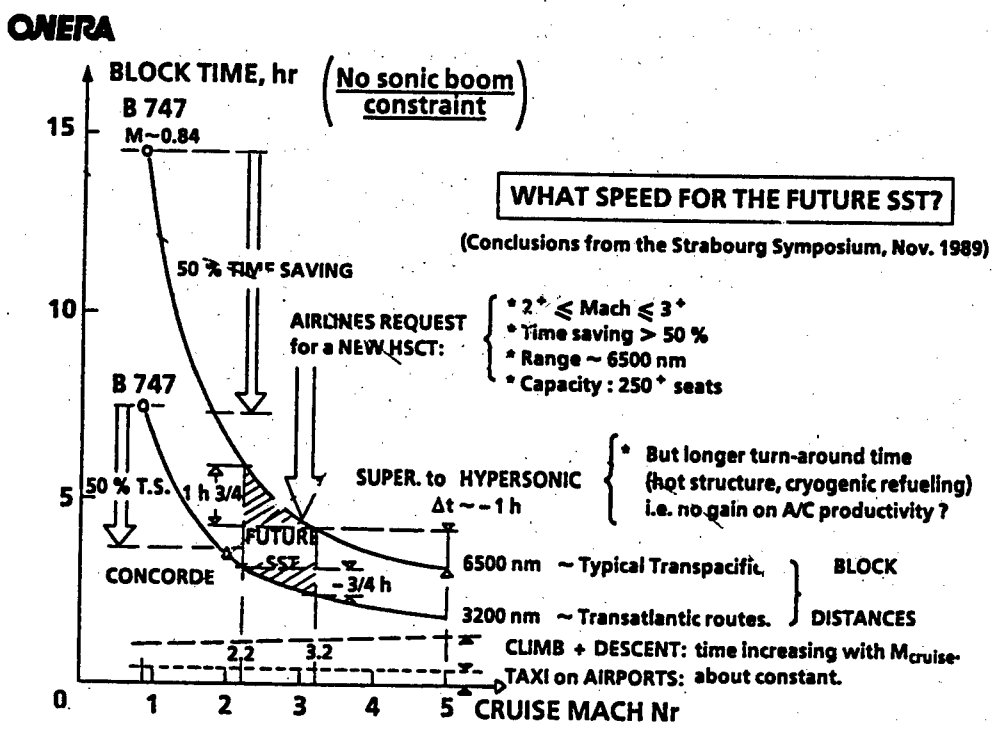
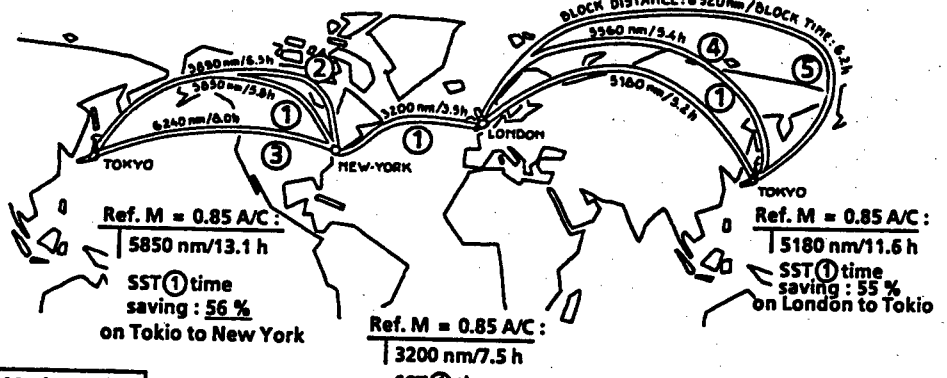


Figure 3

Aérospatiale-FUTURE MACH 2+ SUPERSONIC TRANSPORT OPERATION AROUND THE WORLD
INFLUENCE of the SONIC BOOM CONSTRAINT ON BLOCK TIME and OPERATING COST



	Mach 2 cruise		
	Δ time	Δ D.O.C.	
	Base	Base	① GREAT CIRCLE ROUTE, ALL SUPERSONIC (no sonic boom constraints)
TOKYO N.Y	+ 8 %	+ 5 %	② Detour + SUPERSONIC over sparsely inhabited area + SUBSONIC over populated area
	+ 38 %	+ 25 %	③ Detour + SUBSONIC over land
LON TOKYO	+ 6 %	+ 5 %	④ Detour, ALL SUPERSONIC, including over sparsely inhabited area
	+ 20 %	+ 19 %	⑤ Detour, ALL SUPERSONIC over ice/water

Figure 4

composites for the main parts of the airframe, which will enable large reduction on structural weight compared to Concorde.

But, by definition, a supersonic transport must be "thin and slender," which means a very flexible structure: large deformations under loads in flight for the wing (2-3 percent thickness) but also for the very long slim fuselage during Concorde development have required much attention (corrections on elevon setting laws, damping of the nose pitch excitation on bad runways, etc.).

Another spin-off of Concorde experience concerns the various advanced systems and mainly the first civil application of a fly-by-wire concept (Figure 17) with sophisticated electrical flying control system and hydraulic supply. The most useful system for increasing aerodynamic efficiency at supersonic cruise is the automatic fuel transfer system when crossing the transonic regime, illustrated in Figure 18 [not reproduced]. But for the future SST, we need to take advantage of a subsonic relaxed stability, based on a reliable active control system: the large gain on aerodynamic efficiency at subsonic speed was validated during a unique flight research programme performed by Aerospatiale on a modified Concorde (this "demonstrator" aircraft was equipped with a special digital fly-by-wire system and with a side-stick for the experimental pilot), also illustrated in Figure 18: this potential gain is most important on this tailless airplane configuration to reduce the fuel consumption during subsonic climb and cruise but also to decrease the regular fuel reserves weight, and to reduce the landing speed (positive elevon setting).

The future SST cockpit layout (Figure 19a [not reproduced]) must take advantage of large progress made, since the Concorde design, on the desk presentation, based on large cathode ray tubes in the loop of a Flight Management System, already operational (Airbus, etc.). Furthermore, it is mandatory to save the large structural weight of a droop nose system (Concorde, Tupolev 144) imposed for the pilot vision at near α near the ground; studies must be undertaken to develop innovative configurations, for example a nose-up shape (Figure 19b [not reproduced]), complemented by wide-angle video camera visualization; existing ground simulators are well suited for such research.

The Concorde propulsion system development has been the most difficult challenge during the design and the prototype phases (see Ganley-Laviec paper in Ref. 1).

For a Mach 2+ cruise speed, an external compression scheme for the air intake was certainly the best and safest choice, but the main problem has been the integration of the boundary layer bleed as a secondary flow in the nozzle, and then the air intake control system operation (Figure 20 [not reproduced]). In fact, Concorde inlet efficiency is very high (for Concorde $\rightarrow$, 1 percent loss on intake efficiency means 2.5 percent, 1 percent and 5 percent payload reduction respectively at supersonic, subsonic and take-off regimes; it is still valid for a future SST) (η similar to 0.94 at Mach 2) and the R.R. Olympus is still one of the best supersonic engines in the world (SFC = 1.19 lb/lb/hr for Mach 2); but two crucial deficiencies of this simple turbojet are well known: its too large fuel consumption at subsonic speed and its now forbidden level of noise around airport.

For the next generation SST, the major engine manufacturers are working on various by-pass schemes to increase the mass flow and to reduce the jet speed at subsonic regimes;[14-17] the candidate engine configurations for the AS Alliance project have various different concepts: a by-pass turbojet with an ejector nozzle mixing airflow after the turbine (Pratt and Whitney), or low by-pass engine with inverted primary and secondary flow (General Electric), or large secondary fan flow added to low by-pass ratio fan engine; this last concept is studied, in the framework of a European research programme[17] by MTU, SNECMA and Rolls-Royce; three schemes (Figure 21 [not reproduced]) are based on secondary intake and exhaust duct implemented on individual nacelle, to be operated at low by-pass ratio for high efficiency supersonic cruise and at increased by-pass ratio for better efficiency during subsonic flight phases, but also for low noise regulatory constraints during take-off and landing.

In fact, this environmental noise is a major challenge for the viability of a future SST: a crucial objective of the Aerospatiale Alliance project is to meet the ICAO noise level thanks to this new variable cycle engine concept with some more noise abatement system in the nozzle (Figure 22a [not reproduced]), without too large thrust losses.

As seen previously, the sonic boom (Figure 22b [not reproduced]) propagated over the ground in supersonic flight is an unsolved problem, even if it seems possible to reduce a little the overpressure signature by a specific airframe shaping (with some losses on the aerodynamic efficiency). If some authorized "corridors" over desertic area are allowed, this problem could be less penalizing for a very long range SST, because of its large decreasing weight and its higher cruise altitude at the end of its supersonic cruise leading to a much reduced overpressure. But the "superboom" focus during the supersonic acceleration remains about twice that found in cruise and requires very specific authorized "desertic area" around the world (see Figure 2).

Finally, another challenge for the future SST programme managers will be to "demonstrate" that a fleet of 500 to 1000 aircraft have a negligible effect on the ozone layer depletion; such demonstration requires considerable basic research, including stratospheric flight experiments for chemical analysis and use of satellites; such studies are in progress in France, in a close international cooperation. (Aerospatiale, British Aerospace, Deutsche Airbus, Boeing and McDonnel/Douglas have started a cooperation mid 90 (joined by Alenia, JABC and Tupolev in 1991), with three objectives: market evaluation, environment issues and certification.) In the meantime, it seems reasonable to choose a supersonic cruise flight below the maximum of ozone concentration, i.e. at Mach 2+ only (Figure 23a [not reproduced]), and to strongly reduce the production of nitrogen oxide NO_x thanks to new types of combustion

chamber on the SST engines (Figure 23b [not reproduced]); but is it either necessary or sufficient? At this stage, it is fair to quote a statement from S. J. Swalding[4]:

"Since mid-70s, concern for the ozone layer has focused on the effects of chlorine (and bromine) from the now infamous CFCs and similar chemicals.

"But, both NO_x and chlorine (and bromine) react with ozone and destroy it. Reactions between NO_x and chlorine themselves, however, result in molecules that do not attack ozone. Conversion of these 'reservoir' molecules back into ozone destroying forms, can take place on the surfaces of stratospheric ice crystals and sulphur particles—leading, for example, to the Antarctic ozone 'hole' and perhaps to the low amounts of ozone measured (by European and American scientific expeditions) over mid latitudes of the northern hemisphere. Also taking place on the surface of those ice or sulphur particles may be reactions that convert NO_x into a form that does not attack ozone.

"Recent work at the University of Cambridge has concluded that...the direct impact of high speed civil transport is likely to be much less than previously thought..."

IV. Some Objectives for a Future SST Project

To complete this brief overview, it seems interesting to sum up the philosophy of the French Aerospatiale manufacturer on its "ALLIANCE," with some references to similar views of British Aerospace Company on its Advanced Supersonic Transport study (AST) in UK.[4]

Some Aerospatiale objectives are summarized on Figure 24 [not reproduced], which needs some comments:

—The supersonic cruise Mach number will be kept slightly above 2, in order to minimize the problems arising with excessive kinetic heating (strength of metallic and composite materials, marginal heating of a necessarily "conventional jet A" kerosene, increasingly difficult air conditioning systems) and to avoid the problems connected with a more complex operation of mixed-compression air intakes (required above about Mach 2.2); besides, higher Mach numbers do not bring about any gains in block time sizable enough to justify the additional production and operating costs.

—On the aerodynamic side, successive preliminary design improvement since 1978 resulted in a large increase of the lift/drag ratio compared to Concorde (Figure 25 [not reproduced]); this was obtained for supersonic (M = 2.05) and subsonic (M = 0.95) cruises, thanks to computational shape optimization (including area ruling on wing apex area) and mainly a larger wing span. As shown earlier, much better low speed performances are required in order to increase lift and to minimize drag for reducing both fuel reserves and noise near airports; much more research and validations are necessary to develop innovating high lift systems. Finally, an active control system integration for a safe relaxed longitudinal stability is also most important to improve subsonic performances.

—On the propulsion side, Aerospatiale is open to the various engine manufacturers proposals, based mainly on the variable cycle concept in Europe (see Figure 21). Considerable technological progress is expected on internal aerodynamics (compressors, turbines) and on new high temperature materials (intermetallic/metal matrix, titanium and ceramic matrix composites, etc.); thus, SNECMA objectives for a future SST engine, compared to the Concorde/Olympus are impressive: plus 33 percent on the take-off thrust/weight ratio, minus 10 percent and minus 25 percent respectively on the specific fuel consumption in supersonic and subsonic cruise, an 80 percent reduction on the NO_x emission.

Strong reduction on the jet noise, complying with airport regulations (jet velocity lowered to about 450 m/sec instead of 870 m/sec for the Olympus engine, combined with an acoustic treatment of the nacelle).

These engines will be integrated to the wing lower surface, inside four individual nacelles, to reduce their drag and to avoid interaction problems (surge phenomena) encountered during the development of Concorde twin inlet. The air intakes, still with a two-dimensional external compression scheme, will have a vertical twin-ramp compression system to reduce the nacelle length (see Figure 21).

This expected progress on aerodynamics, propulsion and materials explains the large gains possible on the specific aircraft weight and specific mission fuel, when compared to Concorde on Figure 26 [not reproduced].

—Concerning the range, the first objective is to ensure a 5500 nm mission with a full payload of 250 passengers and with the regular fuel reserves; a typical 5500 nm mission profile is given on Figure 27 [not reproduced], which shows that a large part of the fuel carried is burned at subsonic speed for its acceleration (19 percent) or for possible holding and diversion before landing (10 percent), thus, every progress on subsonic aerodynamics and on engine S.F.C. is most important for further range improvement.

With a later installation of a laminar flow control for supersonic drag reduction, it is expected to reach a 6500 nm range on a derivative configuration.

The same Figure 27 shows that, in the gross weight breakdown, the payload remains a sensitive small part (8 percent), but better than Concorde (6 percent) and with a much larger range.

Finally, the Direct Operating Cost calculated for the Alliance project is compared in Figure 28 [not reproduced] to the D.O.C. of a typical modern subsonic aircraft (B-747-400) for a 4300 nm trip: the fuel cost percentage in the D.O.C. is 8 percent larger for the SST. When looking at the D.O.C. sensitivity on the same figure, two parameters are important: aircraft price and its annual productivity in operation; the first one depends upon progress in design and manufacturing methods; the other is related to airline methods of operating a SST in conjunction with a subsonic fleet, and on optimization of its utilization (taking into

account night curfew on airports, local time around the world, eastbound or westbound trip, etc.); but the most important is to ensure a very good reliability for all the elements of a sophisticated SST airliner (engines, equipments, systems, etc.); again, lessons learned from the Concorde operation are of great value: its 93 percent mean dispatched reliability must be compared to the 98-99 percent value obtained on the most recent subsonic transport. Such level must be another important objective for the future SST, with less maintenance penalization (Concorde requires about four times the maintenance hours than a B-747).

On the British side, the general philosophy on a future SST is very similar; British Aerospace[4] is designing a "datum" Advanced Supersonic Transport (AST) sized to carry 280 passengers, 5500 nm, with a cruise Mach number of 2.05 (Figure 29 [not reproduced]); this configuration has a slender wing and a small canard to trim high lift flaperons and to improve pitch control versus Mach number. The time-scale for the study and development of this project is similar to the Aerospatiale proposal, both in accordance with SNECMA/Rolls-Royce plans for an advanced engine development (which includes demonstrators); entry-into-service of such projects would be hopefully around year 2005.

V. Concluding Remarks

A high-capacity, long-range supersonic transport will probably make its maiden flight within the next 15 years; this SST will meet the pressing needs of the market for an aircraft capable of cutting in half the flight time between major megacities around the world.

But this ambitious programme has a market limited to only 500-1000 aircraft, with a high development cost (more than $10 billion?); at first, to reduce the risks, a short term cooperative research programme must be launched on its economical viability, on advanced technologies (it is mandatory to validate in sophisticated ground facilities and then on flight demonstrators most of the innovative technologies in aerodynamics, structures/materials, propulsion and equipment), and on environmental issues; then, after a worldwide competition, the next step would be the development of a single supersonic transport built in cooperation that is acceptable to the community and operationally viable for the major world airlines.

Finally, I want to pay homage to our dear old Concorde, still able to fly fast enough around the world (Figure 30 [not reproduced]) to break a very famous speed record! But now it is time to prepare its successor!

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Towards the Intelligent Structure

93WS0442C Nagoya PROCEEDINGS OF INTERNATIONAL AEROSPACE SYMPOSIUM '92 in English pp 188-193

[Article by Peter Gardiner, director, Smart Structures Research Institute, University of Strathclyde, Glasgow G1 1XW, Scotland]

[Text]

The Concept

The terms *Intelligent Structures* and *Smart Structures* have only recently penetrated the lexicon of accepted technical technology. However, the concept that it entails, that of enhancing the functionality of materials and structures, is not new. For hundreds of years, nature has been held as an inspiration for scientists and designers, because biological systems have the unique capability to adapt materials properties in response to changes in the environment. The range of functions that exist in nature is enormous; change of shape, colour, orientation, form, load bearing distribution, and the ability to self repair and regenerate are some but to name a few. The task of transferring some of these concepts into synthetic materials with everyday utility is the goal of a growing number of engineers and scientists world-wide.

For many scientists and engineers, dealing with everyday technical and business problems, the concept of making materials more "livable" can appear far out. However, if we just consider a small number of primitive functions, things become more realistic and tangible. For example, consider the following functions:

- sensing
- actuation
- information processing

Here a definite analogy to biological systems is evident (nerves, muscles and brain), but there is more than one way to achieve the required functionality. Two key themes are currently being addressed:

(i) Systems utilising integrated, discrete sensing and actuation elements attached to or embedded within a host structural material. These can include fibre reinforced polymer composites, concrete, nylon and even conventional metallics and alloys.

(ii) Systems in which functionality is achieved by "growing in" at the molecular/micro structure level of the material. This is much closer to the biological model and may not even result in discrete physical devices such as sensors and actuators being present.

Much activity to date has concentrated on the former of these two themes and associated uses, and benefits have been identified. As a result, the bulk of the work reported in this paper will reflect this, but the growing interest is learning from natural systems to generate intelligent functionality should be noted.

Uses and Benefits

Real engineering problems have been identified, in a number of industrial sectors, than can be by alleviated employing to some degree the concept of intelligent structures. Two key applications stand out; structural monitoring and structural control.

Structural Monitoring

The availability of on-line information from sensors, detailing inherent condition of a structure offers some important benefits:

- improved manufacturing/construction through monitoring key process parameters enabling increased quality, less wastage and hence reduced production costs;
- the higher confidence in structural integrity hence safety improvements;
- improved procedures, such as on condition maintenance, can replace routine, repeated maintenance, hence cost savings;
- access to records of structural loading and environmental exposure and the effects of these on the structure, helps next generation design;
- by monitoring performance of new light weight materials such as composites, greater confidence of use can be provided, hence reduces over engineering.

Structural Control

Such systems consist of some sensory function(s) complemented by a control system to effectively permit, via a dynamic control loop, the use of actuators to control structural properties. This can involve the control or tuning of elasto-mechanical properties such as shape/profile, stiffness or natural frequency and also position or displacement of components. This capability presents a number of benefits:

- improvements in structural life arising from the inherent ability to adapt structural condition including vibration control (reduces fatigue), positional control in bearings and joints (reduces wear);
- improvements in structural performance by optimising positional accuracy (stability), controlling surface features (hydro-dynamic and aerodynamic flow), vibration control (reduces noise).

European Activity

European activity to date has mostly concentrated on structural monitoring systems but with a recent growth interest in structural control. Interest in the intelligent material concept spans a wide range of industrial sectors including off-shore, medical, process industries, automotive, consumer but this paper concentrates on two prime areas, that of aerospace and civil structures. In the limited space available, it is difficult to do justice to the field, so please accept my apologies for any omissions.

Aerospace Structure Applications

A number of key influences are present that are drawing interest in structural monitoring; for example:

- the industry has a growing fleet of ageing aircraft; prediction and hopefully extension of life is desirable.
- new aerospace materials, for example, carbon reinforced composites, have unique responses to impact and assessment of damage and loading is essential.

The availability of in-built, on-line, continuous monitoring of aerospace structures will obviously improve safety and save cost due to more efficient inspection and maintenance procedures.

A number of comprehensive projects have been undertaken in Europe, aimed at developing and proving this technology.

Much emphasis has been put upon the use of fibre optic sensor systems to monitor composite materials. A comprehensive European collaborative project OSTIC (Optical Sensing Technologies for Intelligent Composites) was completed about one year ago. This was part funded by the European Commission and involved partners from the UK (University of Strathclyde and AEA Harwell), France (Bertin and EDF) and Italy (CISE and Alenia).

This project demonstrated distributed fibre optic sensing techniques in composites for strain and temperature measurement and also addressed in detail the practical fabrication and reliability issues (Ref. 1). A new programme has just received the go ahead for funding from the European Commission which builds upon OSTIC and looks at structures and materials other than composites.

MBB in Germany has been very active in the development of in-flight health monitoring technology and have addressed not only a range of instrumentation techniques (optical and piezoelectric for acoustic, strain, acceleration sensing) but also the signal processing and interpretation functions using neural network processing (Ref. 2). In addition, initial information of flight testing of fibre optic strain sensing has been published (Ref. 3). A number of other organisations are active in related areas and include British Aerospace (UK), Thomson CSF (France), Per Udsen Co. (Denmark), University of Brunel and the Cranfield Institute (UK), Institute of Optical Research (Sweden) among others.

Structural control is being actively developed for aerospace structures at various groups. The most noticeable project is ARES (Actively Reacting Elastic Structures) centred at DLR in Germany (Ref. 4). This generic project is aimed at structural control of space structures for improved performance; vibration damping of fixed and rotating wing vehicles for fatigue and noise improvements and dynamic load alleviation as in reducing flutter. This technology is also being assessed for use in automobiles (Volkswagen) and conceivably buildings.

An important part of this project is the development of new control systems for dynamic structures which have been ratified through practical experimentation (Ref. 5).

Other related work has been conducted in Italy at the Universities of Rome and Bologna (Ref. 6) on space structures and a space-borne smart structures experimental system is planned on a UK satellite STRV-1 (Ref. 7).

Civil Structure Applications

The structural condition of large civil engineering structures, in particular bridges, is currently of great concern. The problems arise due to the difficulty in predicting operational conditions some way into the future life of a structure which may have been designed for a 100-year life. For example, loading levels can grow unplanned and natural or man-made environments may also change, for example, excessive application of salt for ice protection.

This has resulted in structures reaching levels of degradation many years before reaching the expected design life. As a consequence, exhaustive inspection and maintenance measures have to be taken. In many cases, the detection of structural damage has been established far too late resulting in essential and very expensive remedial maintenance being required.

Statistics issued by the French government body, Laboratoire Central des Ponts et Chaussees (Ref. 8) has indicated the very poor state of bridge structures. This is summarised below in Table 1.

Table 1. Bridge Problem Statement

	Europe: e.g. France	USA
Existing Structures	230,000 Road Bridges, 23,000 Long Span	570,000 Road Bridges
Covered Span	50×10^6 m^3	230×10^6 m^3
Re-Construction Estimate	£15 billion	£45 billion
	Structurally deficient and functionally obsolete bridges - 1% to 5%	Structurally deficient bridges - approx. 20%

(Source - Ref. 1)

One of the key needs is to monitor the condition of reinforced concrete and in particular the tensioning tendons that are used to keep concrete under compression. A German company, SICOM, has installed, in various bridges across Europe, fibre optic based systems to monitor the condition of these tendons which can deteriorate due to corrosion (Ref. 9). Other parameters relevant to structural engineering are corrosion and crack presence and growth.

This application area is growing and R&D activities are underway at the University of Strathclyde (Scotland), CISE (Italy), and Institute of Structural Engineering (Germany), to name a few, and a number of physical and chemical parameters are of interest. Other structures such as dams, tunnels, shafts and earth works are all relevant to this approach.

Activities are also growing in the control of civil structures either for wind gust alleviation or for geoseismic ground movement tolerance (Prof. Casciati, University of Pavia, Ref. 10).

Materials Related Activities

Much R&D activity has been undertaken in the field of materials which can alter one property under the influence of an external stimulus, and includes piezoelectric, magneto-strictive, shape-memory, among others.

Some workers in the field refer to these as smart or intelligent materials. However, it is the author's view that it is the application and integration of these materials to achieve a desired functionality in a structure that can be considered intelligent.

In Europe, shape memory alloys are being actively researched in the Netherlands at Twente University (Ref. 11) and the Cranfield Institute (Ref. 12) and Belgium at Leuven (Ref. 13).

Ceramic and polymeric materials exhibiting the piezoelectric effect are actively being researched as actuator and sensor devices at various institutions (for example, Ref. 14).

Electro-rheological fluids are well researched (Ref. 15) and the use of intelligent polymers is receiving considerable attention; for example in pharmaceuticals (Ref. 16), packaging and labelling (Ref. 17) and with the use of conducting polymers.

UK Government and Institutional Activities

The Department of Trade and Industry has commissioned a study to evaluate the impact on intelligent materials technology on the UK industry and the economy. Results will be disseminated in early 1993.

In the UK, the Institute of Materials has established a working party to develop a strategy for Smart Structures and Materials which has been running for approximately a year. This consists of representatives from government, academia and industry and will provide another forum for discussion and dissemination of information and to help develop a national strategy.

In a related area, approximately one year ago, the European Intelligent Buildings Group (EIBG) was established. This group has defined an intelligent building as "one that creates an environment that maximises the efficiency of its occupants while at the same time allowing effective management of resources with minimum life-time costs." This is an interested party group that is looking at the whole range of building technologies such as structure, environmental control, communications, etc.

Conclusions and Outlook

The concept of enhanced functionality in structural systems—*intelligent structures*—is now recognised as a key emergent technology.

Much of the contributory, enabling science and engineering disciplines are in place, but to enable commercial exploitation, a framework to address the critical issue of integration has still to be fully established. Some activity has started, for example the establishment of research institutes and centres, such as at Strathclyde, and the gradual build up in industrial awareness of what is offered. However, a wider framework has yet to develop.

Targeted, industrially orientated activity must evolve as well as fostering and nurturing a broader inter and intra disciplinary culture in the academic community.

A key aim of this is to ensure that the appropriate design methodologies are adopted; that is *to design for smart.* This means that intelligence is designed into structural systems at conception and not added on at the end.

If this can be achieved, the future looks very bright for intelligent structure technology with great promise of commercial opportunity in the near, as well as long term.

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Ariane 42L To Make First Launch

93WS0444A Paris AFP SCIENCES in French 15 Apr 93 pp 10, 11

[Article: "Preparations for 56th Ariane Launch"]

[Text] Kourou—Preparations are being expedited for the launching of the 56th, and this year's first, European rocket Ariane, scheduled for the night of 29-30 April, at the Guyanese Space Center at Kourou, from where it is to lift into orbit the SES's [European Satellite Company's] Luxembourg direct-TV satellite Astra-1C, and the RACE's [Radio-Amateur Space Club's] Arsene satellite.

For this launch, Arianespace will be using an Ariane 42L launcher for the first time. Equipped with two liquid-fuel booster rockets, it is the last of the six models in the Ariane 4 panoply.

Having undergone a series of transformations, after having originally been prepared to launch the Galaxy-IV telecommunications satellite on 21 January for the U.S.-based Hughes Communications company, the launcher was transferred from the integration facility to the forward zone of the launch platform on 13 April.

Originally equipped with an H-10 Plus third stage and two dry-fuel boosters, the 56th Ariane now has, for the launch of Astra-1C, an H-10 third stage, which is less powerful than the H-10 Plus, and its two boosters are now liquid-fuel rockets. These modifications were decided after it was learned that, for technical reasons, Galaxy-IV would no longer be a passenger aboard the 56th Ariane.

For Arianespace's teams, the disappointment of the postponement of the launch from January to the end of April, rapidly gave way to their desire to "take on something new," and thus add to their technical firsts. Never before had a rocket, completely ready for launching, had to about-face and retrace its steps to the hangar in which its stages had been assembled.

It was not a mere matter of turning it around and hauling it back, securely upright on its launch platform, over the two kilometers that separate the launch facility from the integration zone, with 19 tons of dry fuel attached to its first stage and divided up between its two dry-fuel boosters.

They therefore had to disassemble these two huge "firecrackers," bearing weather conditions in mind, so as to avoid all risk of their being struck by lightning. Next, the payload would be different, and this required replacement of the third stage. All these operations necessitated as much attention to detail, and as much checking "by the numbers," as the original assembly of the launcher.

Prior to all of the above, the Galaxy-IV satellite had to be dismounted. This was also "a first, in that, until then, a satellite installed on its launcher had but one destination: space," says Mr. Roger Solari, Arianespace manager at Kourou.

[Box]

Guyanese Space Center's 25th Anniversary

On 9 April 1993, the Guyanese Space Center celebrated its 25th birthday, in the presence of its personnel and of former officials of the CNES [National Center for Space Studies], who had supervised the design of this base that, over the years, has become Europe's "space port."

It was on 9 April 1968 at 0957 hours local time (1257 GMT) that the lift-off of a Veronique meteorological rocket marked the entry of the Space Center, whose construction had begun in 1966, into its operational stage. After a propulsion phase of 45 seconds and a ballistic phase, the little rocket reached an altitude of 113 kilometers.

In addition to its symbolic aspect, the concrete purpose of this flight was to test a recovery system mounted on this rocket without any other payload. Veronique's nose cone, with the recovery caisson for scientific instruments was recovered at sea, 30 kilometers from Kourou. A page of France's space adventure had thus been successfully turned.

Upon its creation, in 1962, the CNES immediately undertook a survey of sites for the installation of a launch complex to replace Hammaguir, in the Algerian Sahara. The choice settled on was Kourou because of its favorable geographical and climatic characteristics. Its opening to the sea was suited to the launching of satellites over an angle of 120°, and with total security: northward for polar orbits, and eastward for the geostationary orbit.

The spectacular career of the Ariane rockets, beginning in 1979 as it did, has borne out the wisdom of this choice. What is more, in the launching of geostationary satellites (telecommunications, meteorology), for placement at 36,000 kilometers above the equator, its immediate proximity to this line of demarcation between the two hemispheres contributes a gain of approximately 17 percent in weight reduction, enabling a saving of fuel, by comparison with launches from Cape Canaveral in the United States.

Eutelsat Test of System 2000 Successful

93WS0444B Paris AFP SCIENCES in French 8 Apr 93 p 15

[Article: "A New Digital Television System - System 2000 - Tested Successfully Aboard Eutelsat Satellite"]

[Text] Paris—A new digital television system has been successfully tested by the European Telecommunications Satellite Organization [EUTELSAT] and NTL [National Transcommunications Ltd].

System 2000 was developed by NTL, and was tested aboard the EUTELSAT-I-F4 satellite. It showed that at least four digital television channels can be transmitted via a single satellite channel such as is normally used to transmit a single television channel, the NTL announced on 2 April.

These tests are part of a series that began in 1991, to demonstrate the digital television signal transmission capabilities of satellites, using data compression techniques. They are of interest to EUTELSAT and the big European television companies (EBU, BBC, RAI, TDF, etc).

Belairbus's Role in Airbus, Future Prospects

93WS0450A Brussels LE SOIR (ECO-SOIR SUPPLEMENT) in French 23 Apr 93 p 6

[Article by Pierre Bary: "Belairbus Playing With the Big League"—first paragraph is LE SOIR (ECO-SOIR SUPPLEMENT) introduction]

[Text] The Belgian partner of Airbus Industrie has signed commitments for over 1,000 aircraft.

Although it does not belong to Airbus Industrie's "major league," like Deutsche Airbus or British Aerospace, Belairbus—the Belgian partner—nevertheless maintains its rank in the European aircraft manufacturing consortium, with a modest but quite tangible participation of some 2 percent. It could have been more if we had joined the venture at the start, 25 years ago. But Belairbus was created only in 1979, by Sonaca [National Aircraft Manufacturing Company], Asco and Eurair; as a result the Belgian group did not get contracts either for the A300, or for its variant the A300-600 which is still being manufactured today. On the other hand, it came just in time to join the A310 program, for which it took part in the research and development of wing leading edges, and continued with the tooling and production stages. Since then, it has completed 240 assemblies for the A310, 226 of which were delivered on the 263 units covered by firm orders.

Increased Participation on Wings

Having acquired experience and knowhow in this technology, Belairbus offered its services later on, when the European consortium decided to complete its aircraft line with new families, the A320-321 (with a single aisle) and A330-340 (with two aisles). It wanted to retain a similar participation in these new programs which enabled Airbus Industrie to offer a complete aircraft line to compete with Boeing.

Under its agreements with the European consortium, Belairbus was selected for a first installment of these two new programs. Thus, for the A320 alone, it provided close to 500 dual wing-leading-edge assemblies, most of which were used on the 400 or so aircraft currently in operation worldwide, including the United States. It is reasonable to expect that, with the introduction of the newcomer, the stretched A321 model, the potential market for this aircraft family will exceed 1,150 units, taking into account the 800 firm orders that have already been received. For Belairbus, that would represent total sales of about $348 million.

Moreover, in view of the 450 firm orders already signed for the larger A340 and A330 models, Belairbus can already expect sales of $468 million. Quite likely, this figure could be exceeded when economic conditions in the aircraft industry improve.

500 Jobs for 10 Years

To benefit from it, however, Belairbus should keep up its efforts and make additional commitments. This is also what it did a few days ago, after lengthy commercial negotiations that were held in Toulouse. The agreement signed by Messrs Gandibleux, president of Belairbus, and Flosdorff, Airbus Industrie "chief executive," guarantees that the Belgian group will supply leading-edge sets for over 1,000 A320-321 aircraft and 800 A300-340 aircraft, which represents at least 500 jobs for 10 years.

This will be distributed among the three partners in proportion to their interest in Belairbus: Sonaca, 58 percent; Asco, 35 percent; and Eurair, a subsidiary of the Flemish company Watteeuw, 7 percent.

Asco, whose backlogs of orders simply melted away when military investments were cut, now focuses most of its activity on Belairbus, for which it produces essentially actuators and levers used to move mobile wing components. As for Eurair, which is headquartered in Bruges, it supplies gears. Sonaca, which manufactures leading-edge spars is also in charge of supervising the assemblies. In addition, it is the group's natural representative with the European manufacturer.

Mr. Gandibleux does not deny that Belairbus would never have been created without the state's and the regions' help, in particular to finance R&D. He has no intention of shirking his obligations. "In the A310 program," he said, "we paid back over 50 percent of the government's contribution." Not a bad start!

ESA Horizon-2000 Projects Reviewed

93WS0455K Paris ESA PRESS INFORMATION NOTE in English No 07-93, 22 Apr 93 pp 1-5

[Text]

Selection of M2 Science Project

Four Mission Proposals

The final phase of selection for the second medium-sized project—M2—to be carried out under ESA's Horizon 2000 science programme is approaching. The first such project, M1, is the Huygens probe, which is scheduled to be launched on board the American Cassini orbiter in 1997 and penetrate the atmosphere of Titan, Saturn's largest satellite, in 2004.

Formal presentations of the four projects still on contention are to be given on 26 and 27 April to the Solar System Working Group and the Astronomy Working Group, ESA advisory bodies. An ad hoc group has been set up to analyse the STEP mission. On 28 April the working groups will submit their conclusions to the Space Science Advisory Committee (SSAC), whose task it will be to select a single project and propose it, via the Agency's Directorate of Science Programmes and its Director General, to the Science Programme Committee, representing the Member States' scientific communities, which will be meeting on 3 and 4 June to take the final decision.

The Selection Process

In June 1989 a call for mission proposals was issued to the European scientific community by the Directorate of Science Programmes. Almost 30 projects were submitted in response. An initial assessment was made by the working groups.

Throughout the selection process the criteria applied by the various committees have been focused predominantly on the missions' scientific interest and their feasibility within the specified timescale and the predetermined financial envelope.

With the working groups' advice, the SSAC reduced the field to six projects, which were then submitted to an assessment study in conjunction with potential partners and referred back to the working groups. In June 1991 the SSAC and SPC selected four projects to undergo phase A studies by ESA, its partners and industrial contractors.

The four projects shortlisted for M2 are briefly described below:

- INTEGRAL (INTErnational Gamma-Ray Astrophysics Laboratory), an international mission to be carried out in cooperation with NASA and the Russian Space Research Institute IKI to follow on from two current missions, the Russian GRANAT (flying the French SIGMA telescope) and the American Compton Gamma-Ray Observatory (CGRO). With instruments 10 to 50 times more sensitive than those its predecessors, it should bring major progress in gamma-ray astronomy.
- MARSNET (MARS NETwork mission) consists in sending three probes to the surface of Mars to set up a network of seismology and meteorology stations there, in addition to which studies in the fields of geology, mineralogy, aeronomy and exobiology would be conducted. This project would be carried out in conjunction with a similar NASA mission, MESUR (Mars Environmental SURvey). Russia would also contribute by supplying a remote-controlled mini-rover to move sensors around in the vicinity of each station.
- PRISMA (Probing Rotation and Interior of Stars: Microvariability and Activity) is a mission to study the internal structures and atmospheres of stars through detection of microvariations in their luminosities and spectra in the visible and near and far UV bands. It is the only exclusively European mission on the shortlist.
- STEP (Satellite Test of the Equivalence Principle) is a fundamental physics mission devised jointly with Stanford University, USA, and would be a cooperative venture with NASA. The satellite, carrying nine highly sensitive accelerometers, would test the principle of equivalence between gravitational and inertial forces, the basic postulate of the general theory of relativity, with a precision never before achieved. It would also test the validity of Newton's inverse square law and measure the gravitational constant, in addition to which geodesy and aeronomy measurements would be carried out.

The project chosen ultimately by the SPC will be able to start pre-phase B studies as from 1994, prior to the development work proper.

The Unifying Factor in European Space Policy

No scientific project selected by ESA has ever had to be abandoned, and this can be credited to the system of selection under the control of the European scientific community, on the basis of the criteria of scientific interest and technical and budgetary feasibility. The Agency's science programmes are part of its mandatory activities and are therefore funded by all its Member States, whose contributions are indexed to GNP. This funding, currently running at about 10 percent of ESA's overall budget, gives a guarantee of stability, which is carried through into the budgets allocated to projects. In the case of M2, the budget will cover the cost of developing, launching and operating the satellite or probes, while the payloads will be funded separately by the States responsible for them.

Dr. Roger Maurice Bonnet, ESA Director of Science Programmes and the initiator of the Horizon 2000 programme, explains that he sees "medium-sized missions as the flexible part of Horizon 2000, the fixed part being represented by the four 'cornerstones': the SOHO Solar Observatory, the XMM Observatory for X-Ray Astronomy, the Far Infrared Space Telescope, and the Rosetta cometary probe. They are the ongoing expression of the scientific community's aspirations and ambitions. The science programmes are the bedrock of the Agency's activities, the constant component that binds all the

Member States together. With five-yearly budgeting, they are the science programmes with the most stable funding in the world."

A call for proposals for the third medium-sized mission, M3, was issued by the Directorate of Science Programmes last year and the replies, due on 30 May 1993, should yield a further list of ideas, which will be put through a selection sequence similar to the one described above.

Journalists and others wishing to attend the presentations of the four projects, which are to be given in open session at UNESCO Headquarters in Paris on 26 and 27 April, are invited to complete the attached form and return it to ESA Public Relations.

Fokker To Build Robot Arm for Mir-2 Space Station

93WS0462A Rotterdam NRC HANDELSBLAD in Dutch 29 Apr 93 Supplement p 3

[Article by Sjoerd van der Werf: "Fokker Building 'Roving' Robot Arm for Russian Mir-2"]

[Text] The future Russian space station, Mir-2, will be equipped with a Fokker Space & Systems robot arm. The instrument will be an important resource for the astronauts in 1997 when starting construction of the new Russian space station in its orbit around the earth. Developed under commission from the European Space Agency [ESA], the robot can be adapted for activities in space that previously were performed by the space voyagers themselves. Because of a limited supply of oxygen, however, that they could carry along, they were able to remain in space at most between one and six hours. Not to mention that space walks are not without risk. The instrument was originally developed for the European Columbus/Hermes project, but that was put in deep freeze last year. Presently for their manned space travel the Russians are still using the Mir-1 space station launched back in 1986. By now, however, it is beginning to show signs of aging. The new Mir-2 is the most significant Russian space travel project for the future. It is possible that the U.S. also will take part in the Mir-2 program. President Bill Clinton this month hinted that cooperation with the Russians, especially in development of a joint space station, appeals greatly to him. Once Mir-2 is operational, the robot arm to be built by Fokker, will then also be able to be used for maintenance and inspection of the complex. The instrument is particularly suited for use on the new platform since it was designed for a lengthy stay in space. Additionally, and unlike the Canadair mechanical gripping arm for the American space shuttle and the Russian Ljappa, functioning aboard Mir-1, it is capable of moving itself so that the system is able to operate over the entire space station. In coming weeks, Fokker will be determining with NPO Energiya, one of Russia's premier space travel concerns, specifically what tasks will be assigned to the robot arm.

France: Dassault's Ongoing Defense R&D Programs Reviewed

93WS0465E Paris LA LETTRE DU GIFAS in English 22 Apr 93 p 1

[Text]

First Mirage 2000 D Production Aircraft for the French Air Force

The first production version Mirage 2000 D was handed over to the French Air Force on 23 March. The diversified Mirage 2000 D retains the nuclear capability of the Mirage 2000 N already in service and is optimized for carrying a wide range of air-ground weapons fired from stand-off distance (in existence or in development): laser guided bombs, submunition containers, etc. These weapons come in automatic low altitude terrain follow-up version for high speeds. Such missions are carried out under all weather conditions, during day and night.

Their independence resides in the inertia platforms and in navigation reset via satellite. The French Air Force has ordered 90 Mirage 2000 Ds.

Flight Testing of the Falcon 2000

As of 23 March, this wide body twin-jet executive aircraft had made 10 flights during which it logged 26 hours and 15 minutes flying time and displayed the proper operation of all systems. Maximum Mach reached was 0.9 for a maximum altitude of 41,000 feet and a maximum IAS of 370 kts.

Firing Tests From the Rafale C 01 and Deck-Landing Trials of the Rafale M 01

The Rafale C 01 executed its first firing tests from Cazaux in March. On 5 March, the first gun firing tests were made using the GIAT Industries DEFA 791 rapid firing gun while the first missile tests involving a MATRA Magic 2 were made on 25 March. After the tests, the aircraft was handed over to crews of the French Air Force and Navy for analysis of operation and maintenance (VAMON) for the benefit of specialists who will be in charge of these operations. The first two production units, the two-seat Rafale B 1 "Air" version and the single-seat carrier-based Rafale M1 were ordered from Dassault Aviation on 26 March. The first deck-landing trials has just started on 19 April of the Rafale M 01 from the Navy Air Force's carrier "Foch." This will make it possible to fine tune "Marine" aptitude of the carrier-based Rafale.

Dassault - 22 - 04 - 1993 - Contact: Mr. Francois Prigent - Phone: 33 (1) 47 95 86 95.

Aircraft, Missiles Produced in France Listed

93WS0465F Paris LE BULLETIN DU GIFAS in English 22 Apr 93 pp 1-4

[Text]

Main Aircraft

Manufacturers	Type (* Inter Cooper.)	Class	1st flight	Characteristics				
				Span (m)	Length (m)	Height (m)	Empty weight (kg)	All up weight (kg)
AEROSPATIALE	* A 300 B2	Short medium range	28.10.72	44.84	53.62	16.53	77,285	142,000
	* A 300 B4	Medium-long range	26.12.74	44.84	53.62	16.53	79,325	165,000
	* A 300-600	Medium-long range	8.07.83	44.84	54.08	16.53	86,727	165,000
	*A 310-200	Medium-long range	3.04.82	43.90	46.66	15.81	76,501	138,600
	* A 310-300	Medium-long range	8.07.85	43.90	46.66	15.81	77,000	150,000
	* A 320-100	Short medium range	22.02.87	33.91	37.57	11.76	37,800	68,000
	* A 320-200	Short medium range	22.02.87	33.91	37.57	11.76	39,800	73,500
	* A 321	Short medium range	11.03.93	34.10	44.50	11.80	46,900	82,200
	* A 330-300	Medium-long range	02.11.92	58.64	63.60	16.70	113,946	208,000
	* A 340-200	Long range	01.04.92	58.64	59.40	16.70	117,109	251,000
	* A 340-300	Long range	25.01.91	58.64	63.60	16.70	120,430	251,000
	* ATR 42-300	Commuter	16.08.84	24.57	22.67	7.59	10,285	16,700
	* ATR 72	Commuter	10.88	27.05	27.17	7.65	12,200	19,990/ 21,500
DASSAULT AVIATION	Rafale M/B/C	Multipurpose	19.05.91	10.90	15.30	5.34	9,250	19,500
	Mirage 2000	Multipurpose	10.03.78	9.13	14.36	5.30	7,500	17,000
	* Alphajet	Training/Ground attack	26.10.73	9.10	11.74	4.20	3,350	7,500/ 8,000
	* Atlantique 2	Maritime patrol	08.05.81	37.36	32.62	10.69	25,370	46,200
	Falcon 50	Executive	07.11.76	18.66	18.52	6.98	9,250	18,500
	Falcon 900 B	Executive	21.09.84	19.33	20.21	7.55	10,240	20,640
	* Falcon 2000	Executive	04.03.93	19.33	20.23	6.98	8,936	15,965

Main Aircraft (Continued)

Manufacturers	Type (* Inter Cooper.)	Class	1st flight	Characteristics				
				Span (m)	Length (m)	Height (m)	Empty weight (kg)	All up weight (kg)
EUROCOPTER	* SA 341/341 GAZELLE	Light multipurpose	11.05.73	10.50	11.97	3.18	997	2,000
	AS 350 BA ECUREUIL	Light multipurpose	14.10.91	10.69	12.94	3.15	1,146	2,100
	AS 350 B2 ECUREUIL, AS 550 H FENNEC	Light multipurpose	23.03.89, 01.03.85	10.69	12.94	3.15/3.34	1,153/ 1,201	2,250
	AS 355 H ECUREUIL 2, AS 556 N FENNEC	Light multipurpose	21.01.86	10.69	12.94	3.15/3.34	1,407/ 1,451	2,540
	BO 105 CBS 5	Light multipurpose	1975	9.84	11.86	3.87	1,320	2,500
	AS 365 H2 DAUPHIN 2	Light multipurpose	25.11.88	11.93	13.68	3.97	2,243	4,250
	AS 585 UA/ Ah PANTHER	Light multipurpose	29.02.84	11.93	13.68	3.97	2,190	4,250
	BK 117 C1	Light multipurpose	13.06.79	11.00	13.00	3.85	1,765	3,350
	AS 532 UC/ AC COUGAR	Military multipurpose	13.09.78	15.60	18.70	4.92	4,330	9,000
	AS 532 SC COUGAR	Armed naval version	29.07.82	15.60	18.70	4.92	4,520	9,000
	AS 332 L2 SUPER PUMA, AS 532 U2 COUGAR	Civilian transport, Military transport	06.02.87	16.20	19.50	4.97	4,660/ 4,760	9,150/ 9,750
	TIGRE/GER-FAUT	Combat helicopter	17.04.91	13.00	15.60	5.00	3,964	5,300to 5,800
AVIONS MUDRY & Cie	CAP X	Basic training	5.05.83	8.00	5.90	2.05	390	650
	CAP 10 B	Training - Aerobatics	13.06.66	8.06	7.15	1.76	540	760
	CAP 21	Aerobatics - Competition	23.06.80	8.08	6.46	1.52	490	800
	CAP 231/231 EX	Aerobatics - Internat. compet.	8.10.85	8.08	6.75	1.80	600	720
AVIONS ROBIN	R 3000/140	Touring	8.12.80	9.81	7.51	2.66	650	1,150
	R 200	Training	1991	8.33	6.65	1.94	525	780
	DR 400 DAUPHIN 2+2	Touring - Training	1974	8.72	6.96	2.23	535	900
	DR 400 REGENT	Touring - Training	1972	8.72	6.96	2.23	600	1,100
REIMS AVIATION	F 152 - FA 152	Training - Touring	29.04.77	10.15	7.35	2.59	514	760
	F 172	Touring - Training	1.04.63	10.97	8.22	2.68	664	1,089
	F 408 CARAVAN II	Air utility - Transport - Training	22.09.83	15.08	11.90	4.15	2,220	4,468

Main Aircraft (Continued)

Manufacturers	Type (* Inter Cooper.)	Class	1st flight	Characteristics				
				Span (m)	Length (m)	Height (m)	Empty weight (kg)	All up weight (kg)
AEROSPATIALE Aviation Generale (SOCATA)	TAMPICO (Club)	Training	23.02.77	9.77	7.70	3.02	640	1,060
	TOBAGO	Touring - Training	23.02.77	9.77	7.70	3.02	700	1,150
	TOBAGO XL	Touring - Training	18.04.91	9.77	7.31	3.02	715	1,150
	TRINIDAD	Touring - Training	14.11.80	9.77	7.71	2.85	800	1,400
	TRINIDAD TC	Touring - Training	24.08.84	9.77	7.71	2.85	844	1,400
	EPSILON	Military training	22.12.79	7.92	7.50	2.66	863	1,190
	OMEGA	Military training	30.04.89	7.92	7.81	2.66	1,030	1,400
	TBM 700	Executive	14.07.88	12.16	10.43	3.99	1,826	2,984

Aircraft, Missiles Produced in France Listed

93WS0465F Paris LE BULLETIN DU GIFAS in English 22 Apr 93 pp 1-4

[Text]

Main Aircraft

Manufacturers	Performances		Capacity	Engines		Industrial status as of 1.1.1993		
	Max. cruising speed	Max. range endurance	Capacity	Type	Power (daN - kW, 1 kW = 1.36 ch., 1 daN = 1.02 kgp)	Orders	Deliveries	
AEROSPATIALE	950 km/h	4,635 km	(Mixed: 251 passengers)	2 GE/SNECMA CF6-50				
			(Tourist: 269 passengers)	C/C1/C2 or	2 x 23,360 DaN			
	915 km/h	6,765 km	(High density: 345 pass.)	2 PW JT90-59 A				
						475	386	(50 customers)
	915 km/h	6,704 km	Mixed: 267 pass.	2 GE/SNECMA CF6-80 C or				
			Tourist: 285 pass.	2 PW JT9D-7 R4 H or	2 x 26,259 daN			
	896 km/h	6,297 km	High density: 345 pass.	2 PW 4000				
	896 km/h	8,241 km	(Mixed: 218 pass.)	2 GE/SNECMA CF6-80 A/C2 or				
			(Tourist: 285 pass.)	2 PW JT9D-7 R4 D/E or	2 x 22,235 daN	262	224	45 customers
	902 km/h	4,000/ 4,600 km	(High density: 262 pass.)	2 PW 4000				
	902 km/h	5,300/ 6,500 km	150/180 passengers - 164 tourist passengers	2 CFM 56-5 or 2 IAE V2500	2 x 11,127 daN	856	362	36 customers
	902 km/h	4,350 km	170/220 passengers	2 CFM 56-5B or 2 IAE V2530	2 x 13,300 daN	153	-	11 customers
	945 km/h	9,000 km	2 cl MR 335/3 cl LR 295/1 cl 392/H.D. 428 pass.	2 GE CF6-30E1-AVRR 211-524L/PW 4000	2 x 29,100/2 x 28,900/2 x 28,500	144		14 customers
	945 km/h	13,600 km	3 cl LR 262/2 cl MR 303/ H.D. 361 pass.	4 CFM 56-5C2	4 x 13,900 daN	112		22 customers
	945 km/h	12,000 km	3 cl LR 295/2 cl MR 335/ H.D. 428 pass.	4 CFM 56-5C2	4 x 13,900 daN			
	493 km/h	1,700 km	Crew: 2 + 42/ 50 pass.	2 PWC PW 120	2 x 1,343 kW	302*	238	51 clients (*Orders and options)
	530 km/h	2,620 km	Crew: 2 + 64/ 74 pass.	2 PW 124	2 x 1,790 kW	203*	77	

Main Aircraft (Continued)

Manufacturers	Performances		Capacity	Engines		Industrial status as of 1.1.1993		
	Max. cruising speed	Max. range endurance	Capacity	Type	Power (daN - kW, 1 kW = 1.36 ch., 1 daN = 1.02 kgp)	Orders	Deliveries	
DASSAULT AVIATION	Mach 1.8	In-flight refueling	1 pilot + 1 weapons systems officer; 1 30-mm cannon + 14 carriage points	2 SNECMA M88-2	2 x 75 kN with post-combustion	4	3	
	Mach 2.2	In-flight refueling	1 pilot + 1 weapons systems officer; 2 30-mm cannons + 9 carriage points	1 SNECMA M53	1 x 95 kN with post-combustion	536	371	Of which 157 are for export
	Mach 0.85	4 h 30 min	2 pilots; 1 30-mm cannon + 4 carriage points	2 x Larzac 04 C6 or C20	2 x 1,324 or 1,412 daN	510	510	Of which 335 are for export. The ATS "advanced training system" is in the development stage.
	648 km/h	18 h 15 min	Crew: 10/12; Grenades + torpedoes + missiles	2 Rolls Royce/ SNECMA Tyne Mk 21	2 x 4,500 kW	28	10	
	Mach 0.82	6,480 km	Crew: 2 + 8/12 pass.	3 Garrett TFE 731-3	3 x 1,646 daN	-	230	Of which 223 are for export
	Mach 0.87	7,110 km	Crew: 2 + 12/ 19 pass.	3 Garrett TFE 751-BR	3 x 2,113 daN	-	122	Of which 117 are for export
	Mach 0.85	5,555 km	Crew: 2 + 9 pass.	2 CFE 738 - 1 - 1B	2 x 2,490 daN	-	1	

Main Aircraft (Continued)

Manufacturers	Performances		Capacity	Engines		Industrial status as of 1.1.1993		
	Max. cruising speed	Max. range endurance	Capacity	Type	Power (daN - kW, 1 kW = 1.36 ch., 1 daN = 1.02 kgp)	Orders	Deliveries	
EUROCOPTER	270 km/h	785 km	1 pilot + 4 pass. or a 700-kg cargo sling	1 TURBOMECA ASTAZOU XIV M	640 kW	1,256	1,256	Of which 883 are for export
	234 km/h	730 km	1 pilot + 5 pass. or a 906-kg cargo sling	1 TURBOMECA ARRIEL 1 8	477 kW	1,779	1,865	Of which 1,625 are for export
	245 km/h	660 km	1 pilot + 5 pass/troops or a 1,160-kg cargo sling	1 TURBOMECA ARRIEL 1 D 1	546 kW			
	223 km/h	722 km	1 pilot + 5 pass./troops or a 1,134-kg cargo sling	2 TURBOMECA ARRIUS 1 A (TM 319)	2 x 340 kW	536	498	Of which 449 are for export
	243 km/h	564 km	1 pilot + 4/5 pass. or a 900-kg cargo sling	2 ALLISON 250 C 208	2 x 313 kW	1,311	1,306	Of which 890 are for export
	277 km/h	860 km	1 pilot + 9/12 pass. or a 1,600-kg cargo sling	2 TURBOMECA ARRIEL 1 C 2	2 x 551 kW	574*	513*	Of which 502 are for export. All types *including 100 for US Coast Guard.
	272 km/h	850 km	1 or 2 pilots + 10 troops or a 1,600-kg cargo sling	2 TURBOMECA ARRIEL 1 M 1	2 x 558 kW			
	247 km/h	540 km	1 pilot + 7/10 pass. or a 1,200-kg cargo sling	2 TURBOMECA ARRIEL 1 E	2 x 410 kW	232	221	Of which 211 are for export
	258 km/h	598 km	1 pilot + 21 troops or a 4,500-kg cargo sling	2 TURBOMECA MAKILA 1 A 1	2 x 1,357 kW			UC = Transport, AC = Armed version
	251 km/h	911 km	2 pilots + 1 operator	2 TURBOMECA MAKILA 1 A 1	2 x 1,357 kW	419	368	Of which 360 are for export
	277/273 km/h	851/796 km	2 pilots + 25 pass. or a 4,500-kg cargo sling, 2 pilots + 29 troops or a 4,500-kg cargo sling	2 TURBOMECA MAKILA 1 A 2	2 x 1,376 kW			L2-U2 = stretched version
	260 km/h	800 km	1 pilot + 1 gunner	2 MTU/TURBOMECA/RR MTR 390	2 x 958 kW			5 prototypes on order

Main Aircraft (Continued)

Manufacturers	Performances		Capacity	Engines		Industrial status as of 1.1.1993		
	Max. cruising speed	Max. range endurance	Capacity	Type	Power (daN - kW, 1 kW = 1.36 ch., 1 daN = 1.02 kgp)	Orders	Deliveries	
AVIONS MUDRY & Cie	180 km/h	800 km	Twin-seater	1 LYCOMING	85 kW			2 aircraft testings
	240 km/h	1,000 km	Twin-seater	1 LYCOMING	132 kW	280	274	In production since 1970
	320 km/h	1,400 km	Single-seater	1 LYCOMING AE IO 360	140 kW	39	39	
	320 km/h	1 hour	Single-seater	1 LYCOMING AEIO-540-L1	228 kW	30	27	
AVIONS ROBIN	255 km/h	1,610 km	4 seats + 40 kg luggage	1 LYCOMING LO 360	132 kW	-	50	
	223 km/h	1,050 km	2 seats	1 LYCOMING 0-235 L2A	82 kW	-	-	A variant of R 200 put back into production
	216 km/h	930 km	3/4 seats + 40 kg luggage	1 LYCOMING LO-235	82 kW	-	1,500	DR 400 all types produced
	260 km/h	1,455 km	4 seats + 60 kg luggage	1 LYCOMING LO-360	132 kW			
REIMS AVIATION	205 km/h	1,290 km	2 seats	1 LYCOMING O-235 L2 C	82 kW		2,403	Production suspended
	232 km/h	1,390 km	4 seats	1 LYCOMING O-320 H2 AD	119 kW		2,258	
	445 km/h	2,480 km	10/14 seats	2 PRATT & WHITNEY PT 6A-112	2 x 373 kW	71	86	57 for export, 8 for the Ministries of Defense and Finance. 1 France
AEROSPATIALE Aviation Generale (SOCATA)	204 km/h	940 km	4/5 seats + 25 kg luggage	1 LYCOMING O-320 D 2 A	118 kW			
	237 km/h	1,080 km	4/5 seats + 45 kg luggage	1 LYCOMING 0-360 A 1 AD	132 kW	1,552	1,467	
	260 km/h	1,093 km	4/5 seats + 6 kg luggage	1 LYCOMING IO-360 A 1 B 6	141 kW			
	303 km/h	1,285 km	4/5 seats + 65 kg luggage	1 LYCOMING O-540 C 4 D 5	184 kW			
	345 km/h	1,910 km	4/5 seats + 65 kg luggage	1 LYCOMING TIO-540 AB 1 AD	184 kW			
	370 km/h	3 h 50 min	Crew: 1 + 1	1 LYCOMING LO-540 L1-850	220 kW	174	174	
	433 km/h	3 h 10 min	Crew: 1 + 1	1 TURBOMECA Arrius 1D	359 kW		1	Prototype developed
	555 km/h	3,000 km	6/7 seats	1 PRATT & WHITNEY PT 6 A68	515 kW	85	54	

Missiles and Weapons

Type of missile		Type of guiding	Type of propulsion	Ramp weight (kg)	Operational	Exported	Development
AEROSPATIALE							
C22	Air drone	Radio remote control	TRI-60-2 - Turbojet	630	*		
AS 30 Laser	Air-to-surface	Laser	Solid propellant rocket motor	520	*	*	
EXOCET AM 39	Air-to-surface	Fire and Forget inertial midcourse/guidance + active homing head	Solid propellant rocket motor	655	*	*	
EXOCET MM 40	Surface-to-surface	Fire and Forget Inertial midcourse/guidance + active homing head	Solid propellant rocket motor	850	*	*	
EXOCET SM 39	Submarine-to-surface	Fire and Forget inertial midcourse/guidance + active homing head	Solid propellant rocket motor	655	*		
* ANS	Anti-ship supersonic	Fire and Forget inertial midcourse/guidance + active homing head	Liquid fuel ram-jet				*
AS 15 MM15	Air-to-surface	Guided by radar in bearing + radio altimeter	Solid propellant rocket motor	98	*	*	
ASMP	Nuclear air-to-surface		Liquid fuel ram-jet	800	*		*
ERYX	Short range anti-tank	Wire guided infrared command to line of sight	Solid propellant rocket motor	11			*
* MILAN	Anti-tank	Wire guided infrared command to line of sight	Solid propellant rocket motor	11	*	*	
* HOT	Anti-tank	Wire guided infrared command to line of sight	Solid propellant rocket motor	23	*	*	
* ROLAND	Surface-to-air	Radar or optical guidance	Solid propellant rocket motor	65	*	*	
* ASTER	Surface-to-air	Inertial then active homing head	2 stages - solid propellant rocket motors				*
* POLYPHEME		Optic fiber guided					*
SSBS S-3, SSBS S-4	IRBM	Inertial	2 stages - solid propellant rocket motors	25,800	*		*
MSBS M-20	SLBM	Inertial	2 stages - solid propellant rocket motors	20,000	*		
MSBS M-4, MSBS M-45	SLBM	Inertial	3 stages - solid propellant rocket motors	35,000	*		*
LATECOERE							
MALAFON	Anti-submarine	Remote guided	Solid propellant rocket motor	1,480	*		
MATRA DEFENSE							
NICA	Air-to-air interception and close combat	Inertial + IR or active radar homing heads	Solid propellant rocket	110			*
SUPER 530 D	Air-to-air interception	Semi-active electromagnetic homing head doppler	Solid propellant rocket	275	*	*	
MAGIC 2	Air-to-air close combat	IR passive all aspect homing head	Solid propellant rocket	90	*	*	

Missiles and Weapons (Continued)

Type of missile		Type of guiding	Type of propulsion	Ramp weight (kg)	Operational	Exported	Development
CROTALE/SHAHINE	Surface-to-air	Alignment telecontrol	Solid propellant rocket	85	*	*	
ARMAT	Air-to-ground anti-radar	Passive electromagnetic	Solid propellant rocket	570	*	*	
* OTOMAT	Anti-ship	Active homing radar	Turbojet	750	*	*	
*MILAS	ASW	Inertial + torpedo homing head	Turbojet	800			*
APACHE	Air-to-ground stand-off dispenser	Terrain following + radar correlation	Turbojet	1,200			*
MISTRAL	Surface-to-air/air-to-air	IR homing head	Solid propellant	18	*	*	
WEAPONS							
DURANDAL	Penetration bomb	Slow then accelerated trajectory	Solid propellant THOMSON-BRANDT	200	*	*	
F1/F2/F3	Rocket launchers				*	*	
SFA	Slow-down system for off bombs				*	*	
BELOUGA	Dispersion system (151 grenades) Ground attack	Anti-tank, delayed explosion, anti-personnel		305	*	*	
BGL	Laser Guided BGL System	Laser guided gliding air-to-ground munitions		250/400/1,000kg	*	*	
NB: All solid propellants burnt by rocket motors are made by SNPE							
THOMSON BRANDT ARMEMENTS							
BAP 100	Cratering weapon system	Super retarded and rocket boosted	Solid propellant	36	*	*	
BAT 120	Anti-APC (controlled fragmentation)	Super retarded, Focused burst		36	*	*	
CASCAD Mk1	Anti-armoured vehicle (controlled fragmentation)	3 warhead - super retarded		400	*	*	
Multidart 68, 70 and 100	68, 70 and 100 mm sub-munition rockets		Solid propellant		*	*	
Electric multipurpose fuze - FEU 80 FEP 80					*	*	
Air-to-surface rockets. AS/dispersion system (Beluga). Missiles, motors, warheads, SAU of Super 530, R.530, R.550, R.440, Martet, Otomat booster.					*	*	

* Missiles developed and manufactured in cooperation.

Flight Testing, Introduction of Fokker 70 Viewed

93WS0478A Stuttgart FLUG REVUE in German May 93 pp 74-77

[Article by Volker K. Thomalla: "Brevity is the Soul of Wit"]

[Text]

Test Flight of Fokker 70 Takes Off Earlier Than Planned

The Fokker 70 is one of the few aircraft with a prototype in the air before the program has been officially launched. The first customer is to be presented at the Paris Aerosalon at the latest. When building the first example, Fokker used a trick. The aircraft has already flown once as the Fokker 100 prototype.

The Fokker 70 is flying. On 2 April, the three-man crew took off from Woensdrecht in southern Holland for the first flight of the Fokker 70 prototype. Fokker's head test pilot Jaap Hofstra led the crew. Test pilot Jim Hultzer served as the copilot, Marcel van Houten was aboard as the flight engineer. The maiden flight lasted three hours and three minutes—over an hour longer than planned—and ended at Amsterdam-Schiphol according to plan. The machine will now be prepared there for additional flight testing. The crew decided to extend the flight because all

tests ran satisfactorily and it was possible to extend the program. After landing, Hofstra expressed his great satisfaction with the airplane.

By the beginning of June, the entire range of flights, including stall testing and high-speed tests, will be started. This is being done to allow introduction of the aircraft during the technical visitor days at the Salon de l'Espace et de l'Aeronautique in Paris-le Bourget. By then, the Fokker 70 program will also have been officially launched. This step has not yet been taken because of the protracted negotiations between the Dutch government, Deutsche Aerospace (DASA) and Fokker regarding DASA participation in Fokker. On 27 April, after the editorial deadline of this edition of FLUG REVUE, the contracts are to be signed. Shortly after this, according to Fokker spokesman Leo J. N. Steijn, the Fokker 70 program will start officially. Then, the airlines interested in the aircraft also can get firm delivery guarantees and dates. "The fact that Fokker finished the prototype before the launch shows the confidence that Fokker has in the success of the program," says Steijn.

Indeed, it was a few airlines that urged Fokker Aircraft B. V. to derive a shortened version from the Fokker 100—the Fokker 70—and to implement it as quickly as possible. A larger number of airlines from all parts of the world have demanded the aircraft, according to Maarten M. D. van Eeghen, Fokker's director of marketing, and are in agreement with the schedule. They need a 70-seat airplane immediately and, according to information from van Eeghen, do not want to wait for a new power-plant generation to be developed.

Fokker can keep the development time and costs for constructing the F70 prototype low by using a Fokker 100 prototype. Fokker estimated the development costs for the airplane at 350 million Dutch guilders, about 320 million German marks [DM]. This is low compared to development costs of over two marks for a completely new airplane. The F70 prototype was cut into three parts and shortened by 4.62 m at Fokker Aircraft Services in Woensdrecht. This is a wholly owned subsidiary of Fokker performing maintenance and overhaul of accident-damaged aircraft. Now, the F70 prototype has a total length of 30.91 m. The F70 and the F100 exhibit a high degree of construction uniformity, shown by the process used. This will provide potential purchasers with synergy effects and flexibility in crew planning and spare-parts inventory.

The wings correspond to those of the F100 and are manufactured by Shorts of Northern Ireland. The company is participating as a venture-capital partner. Deutsche Aerospace Airbus is providing the tail fuselage. This comes from the F100 with virtually no changes. Deutsche Aerospace Airbus is also providing the bow fuselage section. DASA is participating as a venture-capital partner in the costs and profits, as was the case for the F100. Fokker selected two Rolls-Royce Tay 620 engines, mounted on the tail fuselage, as the power system. Each engine provides 13,580 lbs. of thrust. According to Fokker chief engineer Rudi den Hertog, the Tay 650, which has somewhat more power, can be installed without problems. A few airlines would also like to see this for reasons of commonality. For performance reasons, however, this is not necessary according to den Hertog. Grumman of New York, U.S., is building the power-plant cowlings. The aircraft, according to den Hertog, will meet all noise regulations with ease. It even has a considerable margin if more strict regulations come into effect.

Within the scope of the development work, changes have been made which will be incorporated into the Fokker 100. The Menasco Co. offered Fokker a new landing gear that is lighter, cheaper and better, according to den Hertog, than the old one. In addition, the Fokker JetLine will receive a new cabin interior and a few detail improvements to be used first on the Fokker 70 and then integrated into the F100 line.

A maximum of 79 passengers fit on the aircraft due to the abbreviated fuselage. The airplane comes onto the market as the second member of the Fokker JetLine. In this way, the aircraft moves into a new category where there is nothing comparable—except the four-engine Avro RJ, previously known as the BAe 146. The lower market segment for 30-seat to 50-seat airplanes is dominated by turboprop aircraft with the exception of Canadair Regional Jets. The 100-seat to 150-seat airplanes are all jets. With the Fokker 70, the Dutch manufacturer wants to reach two types of airlines. One type includes regional carriers that want to move from the bottom up to jets but see the jump from a turboprop to a 100-seat plane as too large. The other type is made up of large airlines that already have Fokker 100s in their fleet and need a smaller plane to achieve greater flexibility. Besides, according to van Eeghen, the Fokker 70 can operate economically on routes between secondary destinations thereby bypassing the overloaded hubs of Europe and North America.

In line with the various requests of the airlines, two versions, different in equipment, are planned. One version, which will be preferred by existing Fokker 100 operators, has a flight deck with the same avionics equipment as the F100, including EFIS, FMS, and the instrument for Autoland approaches using CAT IIIb. The version of interest for smaller airlines has a reduced and therefore less expensive set of avionics which still allows CAT II approaches.

In spite of the lack of purchase contracts, the F70 program is moving forward briskly. The first Fokker 70 of series production will be included in the flight testing program. Its initial flight is planned for mid-August 1994. Of the 480 total test flight hours, 30 are to be performed by Serial Number One. In this way, the type approval—incidently, this will be a supplementary Fokker 100 type approval—can be moved forward to October 1994. After this, the first deliveries are planned. This is how fast things can move.

Germany: D2 Space Mission Experiments Under Way

MI0806130493 Bonn DIE WELT in German 29 Apr 93 p 9

[Article by Nicole West: "Scientific Experiments Round the Clock—German Astronauts in Space"]

[Text] After weeks of delays, the German D-2 space mission successfully got off the ground on Monday. Astronaut scientists Dr. Ulrich Walter and Hans Wilhelm Schlegel, together with their American colleagues, are now working in round-the-clock shifts to carry out about 90 experiments in the space laboratory under microgravity conditions.

The first medical investigations were being carried out even while the shuttle was still making its ascent. Schlegel and Walter had been fitted before takeoff with catheters designed to record the pressure in a main vein. About two-and-a-half hours after takeoff, the two physicists removed the probes from their bodies. Even their internal eye pressure and the water concentration in their tissues were recorded during the space flight.

The Columbia space shuttle is now orbiting the blue planet at a height of 296 kilometers and a speed of just under 28,000 kilometers per hour. It takes 90 minutes to orbit the earth. During the nine-day mission, which may possibly be extended by one day, experiments lasting a total of about 210 hours will be carried out in the space laboratory. The two Germans in space are being directed by the DLR [German Aerospace research Institute] space control center in Oberpfaffenhofen, near Munich. The two standby astronauts, Dr. Renate Bruemmer and Dr. Gerhard Thiel, who trained with Walter and Schlegel to carry out the D-2 experiments, are maintaining radio contact there with their colleagues in space. Apart from a few minor faults, the research program on board the Columbia has been completed according to plan so far. On the first day, a refrigerator in the laboratory refused to work, and on the second day a small leak was noticed in a waste water tank; sensors had picked up a sudden increase in the nitrogen concentration on board the shuttle, which must have escaped from the tank. Shuttle pilot Henricks immediately climbed into the lower deck with a spanner and a torch and installed a replacement tank. Problem solved.

The experiments on board the Columbia cover a total of 10 different disciplines ranging from human physiology via atmospheric physics to astronomy. The scientific project leader is Professor Peter R. Sahm from the RWTH Aachen.

Germany: Rotex Space Robot Operates on D-2 Mission; Initial Tests

MI0806124693 Munich SUEDDEUTSCHE ZEITUNG in German 30 Apr/1-2 May 93 p 16

[Article by Erich C. Setzwein: "Robonauts" Still Unsuitable for Tidying Up—German Researchers in 'Spacelab' Try Using Robots in Space for First Time"]

[Text] On Thursday, the "eighth crew member" started work with great dexterity on board Spacelab. The first robot in space, which was developed by scientists at the German Aerospace Research Establishment (DLR) in Oberpfaffenhofen, is called Rotex.

However, Rotex has not yet been much help to the D-2 mission astronauts. The device, which is designed as a gripping arm, first had to be subjected to a thorough checkup. Only then did the robotics researchers on the ground start to transmit their orders into space to have the robot stack building blocks and put a bayonet connection together. The most difficult task will undoubtedly be catching a small, free-floating aluminium dice, and placing it in its correct position.

The robot researchers aim to demonstrate that robots can assist man in space, and relieve him of certain tasks. However, autonomously operating "robonauts" that kept the space station tidy would still be encountered only in science fiction films, said head of experiments Professor Gerhard Hirzinger.

Great interest in the sensitive probing and gripping fingers has been shown by, among others, the medical profession. Hirzinger and his colleagues say that nothing other than the robot's gripping hand could hold a camera rigidly and reliably and reach all the angles of vision that the surgeon needs to see during "laporoscopy," i.e., camera-aided surgery. In addition to the extensive software, remote gripping arm operating system is ready for series production. The "space mouse," with which three-dimensional images can be moved about on the computer screen, will probably soon be available on the open market.

AUTOMOTIVE INDUSTRY

Volkswagen Foresees Further Reduction in Output

MI0906134193 Munich SUEDDEUTSCHE ZEITUNG in German 7 May 93 p 30

[Text] Volkswagen AG of Wolfsburg has to make further substantial cost savings. Costs would have to be cut by approximately one-quarter, said board chairman Ferdinand Piech. Production might have to be reduced by more than the planned 20 percent. Further radical steps, such as investment cuts, could also be taken this year. "If the market declines so much more than we have planned, we shall have to take further drastic measures in the next few weeks," Piech told AUTO, MOTOR UND SPORT magazine.

In the past, VW had "taken refuge in automation," to save wage and payroll-related costs. However, this had led to a state of maximum automation that was not of itself flexible. In the period of short-time working during the first quarter of the current year, VW had decidedly stepped up the quality level. "But we are still doing so with too many people," said Piech. This was one of the factors contributing to the negative results of the first quarter, for which VW had reported a post-tax loss of 1.25 million German marks [DM].

VW will probably coproduce with Hungarian state-owned automobile manufacturer Raba Rt. A VW spokesman said in Wolfsburg that there was an agreement between Raba and the country's VW importer, Porsche Hungaria. VW could supply Raba with light utility vehicles, which would be assembled and completed there. The output, a maximum of 5,000 units, was intended exclusively for the Hungarian market.

In the leasing field, VW is going against the automobile trend. Its subsidiary, VAG Leasing of Braunschweig, supplied 44,700 vehicles in the first quarter of 1993, 5.4 percent more than in the same period the previous year, whereas the group recorded a 23-percent sales drop in Germany over the same period. It was reported that the recession that had started in 1992 had not yet had a critical effect on Volkswagen Finanz GmbH, to which the operating companies VAG Leasing and VAG Bank, Braunschweig, belong.

Germany: Breakdowns, Battery Costs Hinder Electric Auto Development

93WS0482B Duesseldorf HANDELSBLATT in German 18 May 93 p 15

[Article by H.S.: "Electric Cars: Breakdowns in Battery and Passenger Car Production Plants Will Not Allow Them To Go Into Mass Production for Many Years To Come; Batteries are Weakpoint"]

[Text] Duesseldorf, HANDELSBLATT, Monday, 17 May—Influenced by the discussion of environmental concerns, over the past few years politicians, and also representatives of the industry have praised the electric car as the answer to the pollution of densely populated areas, particularly the inner cities, by today's internal combustion engine cars. They have also alluded to strict emission requirements in California in the future (2 percent of new registrations of cars with zero pollutant emissions by as soon as 1998), which can only be met with electric cars. From the latest edition of the industry's PS report, it appears that the euphoria that had prevailed among auto and battery manufacturers has been followed by a sobering-up process during the past few months because of some technical breakdowns.

After a BMW E-1 electric car was burnt out because of a defect in the electronic system and two Asea Brown Boveri, Inc., (ABB) sodium-sulphur batteries also burned up during exposure to high heat caused during startup, the participating firms took appropriate action: BMW discontinued activities with this type of battery and in April ABB withdrew its batteries "from a series of client projects, among others the practical demonstration tests in Zuerich and Ruegen, to rework them." ABB wants to improve the life span and safety of the sodium-sulphur battery in the next four months to be "today's most efficient battery technology" and deliver it to its customers. The next generation of batteries will be available by spring of 1994 with considerably improved performance figures. This, at least, is what Prof. Thomas Hartkopf, the general manager of High-Energy Battery, Ltd., said with regard to the PS report.

Actually, only eight electric cars are in operation on the island of Ruegen instead of the planned 60. BMW, for example, wanted to have seven electric cars on Ruegen, mainly autos of the current third production series. Now that the sodium-sulphur battery "has not held up," the people in Munich [i.e., BMW] are waiting for the reworked ABB battery, but they also want an improved lead-gel battery and a nickel-cadmium battery as well as a sodium-nickel-chloride battery by AEG [General Power Company] included in the tests.

Prof. Christian Voy, the general manager of the German Automobile Company (DAUG), a joint venture between VW and Daimler-Benz, gave as one reason for the auto manufacturer's skimpy participation in it that in Ruegen they have deliberately been using the well-tried lead battery only as a reference. What they are concentrating on is the so-called second generation of batteries, which would either have a substantially greater range than lead batteries or be considerably lighter. And he said that in Zuerich too, along with the lead batteries, they have tested the (also tried and tested) alkaline nickel-cadmium batteries and, finally, the sodium-sulphur batteries, which it has now been demonstrated are nowhere near fully developed.

As regards the cost of electric vehicles, Voy warned against euphoria: Present-day lead-gel batteries could be charged and discharged from about 600 to 700 times as a power source for highway operation before they would have to be replaced. With an average car life of 10 years, one would need three changes of batteries in that timespan at DM4,000 each, or [a total of] DM12,000. It is true that alkaline systems like nickel-cadmium would last for the life of the car, but they would cost DM15,000. So an electric auto would be more expensive than a conventional car by these amounts.

At BMW, however, they think that a cadmium battery for DM15,000 is pie in the sky. At the present time that kind of battery for highway operation still costs about DM90,000, while a sodium-sulphur battery still costs half as much.

Then too, the driving performance of an electric auto—and with it the uses to which the car can be put—is not exactly exhilarating in comparison with conventional cars with internal combustion engines.

If, for example, a BMW-3 in its lowest-power version (316i) with a 1.6-liter engine and 100 HP with a useful load of 450 kg can be gotten up to a top speed of 191 km/h, accelerate to 100 km/h in 12.9 seconds, and have a driving range [with a full tank of gas] of 800 km, the E-1 with 45 HP required 18 seconds to accelerate from 0 to 80 km/h, attain a top speed of 120 km/h, and had a range of about 250 km—and this, mind you, driving without flooring the accelerator. And to boot, the E-1 was right from the start designed to be an electric auto and was one of the fastest of its kind.

But one weakness of electric cars is the mediocre figures not only for acceleration and speed, but also for range. If, for example, the driver of an electric car like the E-1 wants to "swim with" regular city traffic, he will not obtain a range of 250 km, but perhaps only from 150 to 200 km. Then he has to take his jalopy to a socket that is without exception guaranteed to provide 16 amperes of current "to tank up." Fast chargers (at gas stations and garages) for charging batteries in 15 minutes, on the other hand, require considerably higher connection amperages and

would in larger numbers overtax the efficiency of power distribution networks. Furthermore, they are hard on the life of the battery.

In other words, a "purebred" electric car, i.e., an auto with an exclusively electric drive system, is nothing more than a city car, a kind of "rolling shopping bag," and is unsuited to longer trips across country. Its price is plainly higher than that of cars with internal combustion engines since auto manufacturers can only, for the time being, count on very small production runs.

All of the above-mentioned factors are also rather unfavorable in terms of motivating car buyers to get themselves, for example, an E-mobile as a second car. Meanwhile, even among environmentally aware car buyers word has gotten round that an electric car with actually "zero" pollutant emissions leads to additional consumption of electrical energy via the power network. The "night troughs [dips, drops]" in power consumption that once existed are mostly filled up today. If E-autos were driven in large numbers on the streets, new power generation capacities would have to be developed because of it. If they were to be developed with power plants run with fossil energy sources, we would not have solved the CO^2 or pollution problem, but merely shifted it to another area. This is why wider use of electric autos could only be enforced through officially imposed requirements, in accordance with the California model.

BIOTECHNOLOGY

Pasteur Institute Testing Disease-Fighting Cells

93WS0444D Paris AFP SCIENCES in French 15 Apr 93 pp 19, 20

[Article: "New Method of Fighting Against Genetic Diseases: Half Gene-Therapy, Half Organ-Transplant"]

[Text] Paris—A team of researchers of Paris's Pasteur Institute has developed a new gene therapy technique consisting of "pouching" and introducing genetically modified cells directly into the body of a diseased mouse, and not, as is current practice, into the diseased organ.

According to the researchers (Philippe Moullier, Delphine Bohl, Jean-Michel Heard, and Olivier Danos, of the Retrovirus and Gene Transfer Laboratory), whose work is to be published shortly in the British magazine NATURE GENETICS, "this approach produced a remarkable improvement in the condition of the animals." Philippe Moullier, the inventor of this technique, which oscillates between gene therapy and organ transplants, explains that the cluster of cells introduced into the body of the diseased mouse secretes the missing protein continually, throughout the body, and not just in the diseased organ, where the diffusion is only local.

The animals selected by the Pasteur Institute team were afflicted with a genetic disease that prevents cells from ridding themselves of their waste. This anomaly very rapidly affects all the body's tissues. In the case of the mice used at the Pasteur Institute, the enzyme deficiency involved entails lesions of the various organs (liver, spleen, brain) and bone deformations.

Such diseases, linked to the absence or dysfunction of the enzymes that participate in the cellular "tidying up" process, exist also in human beings. These diseases are known as lysosomal storage diseases—a group that includes Gaucher's, Tay-Sachs, and Hurler's among others. They are relatively rare but can be very serious from very early childhood.

To carry out their experiment, the researchers withdrew skin cells from the diseased animals, and placed these cells in a culture together with viruses that would serve as carriers whose function would be to introduce the missing gene into the mouse's genetic material. The cells were then mixed with collagen and artificial fibers, and the mixture, a sort of pouch filled with cells, was introduced into the abdomen of the mice.

According to the researchers, the results are "striking": The cell mass vascularizes very quickly, the enzyme begins to be produced and to be diffused throughout all the organs. Little by little, liver and spleen lesions clear up "spectacularly." The bone deformations, however, once they have set in, appear to be irreversible. This is why the genetic engineers are now testing their method on newborn mice, in which bone lesions have not yet appeared and in which the enzyme, moreover, appears to have better access to the central nervous system.

"This research," says the Pasteur Institute, "is of great interest to clinicians who have no means of treating these diseases other than by very hazardous bone marrow transplants, and, in some cases, extremely costly enzymatic therapies." Use of the technique being developed by this research could moreover not be limited to the treatment of lysosomal storage diseases, but could also be applied to other genetic diseases, particularly those for which medicaments of proteinic origin are used, such as insulin for diabetes, and factor VIII for hemophilia.

Before beginning any testing whatever on humans, the researchers must carry out tests on animals of larger size than mice, in order, on the one hand, to verify that this technique can be used on them, and, on the other hand, to determine whether the therapeutic effect produced in the mice will be produced in other animals as well.

Poll on Dutch Attitudes Towards Genetic Engineering

93WS0462B Rotterdam NRC HANDELSBLAD in Dutch 29 Apr 93 Supplement p 6

[Article by Joost van Kasteren: "Biotechnology Fine, But by No Means Everything"]

[Text] It would appear from different polls that on average the Dutch react fairly negatively when polled on their opinion of biotechnology. When polled, however, about their opinion on concrete applications of biotechnology, then the picture becomes considerably more qualified. Some applications are even deemed extremely positive. Such is what emerges from the results of a still unpublished poll by the Eindhoven Institute of Technology [TU], with a representative random sample of 595 persons. Upwards of 90 percent of those polled has a moderately to very

favorable opinion regarding the use of bacteria to manufacture degradable plastics. A full three-quarters of them likewise have a fairly favorable opinion on the use of genetic technologies to grow new sorts of cabbage and to improve the perishability and hardness of tomatoes, respectively. Those polled are downright negative regarding the use of modern biological technologies in stockbreeding. A little under 60 percent consider cloning of cattle embryos in order to raise calves of identical quality (by now a familiar technology) a bad thing. The same thing goes for using genetic modification to produce BST, a hormone that occurs naturally among cows, so as to upgrade milk production.

Human Gene

Remarkably enough, the insertion of a human gene into cows to counteract mastitis meets with very few objections. Currently there is an ongoing debate between advocates and adversaries regarding Herman the bull whose daughters are to produce the appropriate substance (lactoferrin). That substance would not only help against the occurrence of mastitis but would also constitute a medication against various afflictions including rheumatism. Without mentioning Herman the bull by name and even without referring to the possible use of lactoferrin for rheumatism patients, apparently slightly more than half of those polled (52 percent) were moderately to very favorable in their attitude regarding the application. The poll of Dutch opinion on biotechnology applications was conducted by the Eindhoven TU's Psychology and Language in Technology panel. It was carried out on commission from the ministry of economic affairs. It is planned to repeat the poll yearly in order to track the public's attitude toward biotechnology at the time. According to one of the pollsters, Dr. Cees Midden, a professor of Eindhoven TU, the results make it possible to conclude that the Dutch public is fairly open-minded about biotechnology. Beyond that, the open-mindedness is coupled with a sizable lack of knowledge. In Midden's words: "Emotions play a large role in opinion formation, among other things, when possible risks to health and the environment and ethical aspects are involved. Unlike, for instance, in the case of nuclear technology, there is no mention here of a polarization of positions. Consequently, it is still not possible to speak of a crisis of confidence as with nuclear energy."

Mule

The Eindhoven poll tried to translate the concept of biotechnology, a complex of technologies and products, into applications that were as concrete as possible. To do this the pollsters (besides Midden they were Wim Heijs and Ruud Drabbe) first drew up an inventory of 40 possible and occasionally already actual applications. These were described in such a way that the polled individual could determine just be reading whether a traditional or a new application was at stake. It was also possible from the description to infer what technology was used and whether the object was human, animal or plant. Finally, the description had to furnish information as to precisely what the end product or purpose of the respective application is. The 40 applications, including "the crossing of a horse and a donkey" (practiced for centuries; the outcome is a mule) were submitted in a preliminary opinion poll to a computer panel of upwards of 400 persons. Incidentally, in the preliminary poll the mule got a negative opinion rating. Using statistical techniques (cluster analysis) on the results of the preliminary poll, a number of evaluatory criteria were derived. Put another way: Is there an association between the opinion that people have about one application and their opinion of another application? There did in fact appear to be such associations. On the basis of them it was possible for the pollsters to distinguish nine groups of applications. One concrete application was selected from each of the primary groups and submitted during the principal poll to a fresh group of respondents (see table).

Application:	positive %	neutral %	negative %
Cell fusion of cabbage varieties to grow varieties for other environments	81	10	10
Genetic alteration of tomato plants for longer shelf life and hardness	71	11	19
Cloning of cattle embryos to raise calves of identical quality	29	15	57
Genetic alteration of bacteria with a cow gene for bacterial production of BST	20	16	64
Genetic alteration of cows with human gene for resistance to mastitis	52	16	31
Cell fusion among mice cells to manufacture a pregnancy test for humans	38	20	43
Genetic alteration of rats with human gene for a blood clot solvent	65	14	22
Using bacteria to manufacture raw material for aspartame (sweetener)	53	28	19
Genetic alteration of yeast with cow gene to produce chymosin (coagulant enzyme)	43	30	27
Using bacteria to produce raw material for bioplastics	91	6	3

The Eindhoven poll shows that the public's attitude towards biotechnological applications is mainly determined by emotions and less by reasoning. Knowledge of biotechnology is fairly limited. Enthusiasm and fear are the emotions playing a lead role. Enthusiasm, because biotechnology offers new alternatives for protection of the environment. Hence the use of bacteria to produce degradable plastic can count on a warm reception from the respondents. People also believe that biotechnology will have positive consequences for the economy, notably in the improvement of farm crops and protection of the environment.

Open-minded

It is in stockbreeding that the uses of biotechnology primarily engender feelings of fear. Tinkering with cattle

evokes the fear that certain normative limits are being transgressed. Such feelings of fear show up more often among women than men. Moreover, older folks are somewhat more concerned than younger people. And in addition, CDA and VVD constituents are somewhat more enthusiastic about applications to stockbreeding while PvdA and Green Left constituents have somewhat more feelings of apprehension. All in all the pollsters' conclusion is that the Dutch public is still fairly open-minded in regard to biotechnology. It is their opinion therefore that for further development it is greatly important that government and industry respect the public's open attitude by taking the public seriously. This includes emotions that also play a role no matter how incorrect they may appear in the eyes of the respective scientists. According to Midden: "Experts in the field of nuclear energy have often proclaimed that the chance of an accident in a nuclear plant is smaller than the chance of a meteor crashing into a stadium during the European Cup I finals. This kind of one dimensional reasoning actually indicates the public's apprehensions are not taken seriously. As a result confidence is soon lost. We have seen where that leads in the case of nuclear energy. It is important not to make the same mistake in the case of biotechnology."

France: Genetically Modified Cells Transplanted

93WS0472D Paris AFP SCIENCES in French 22 Apr 93 p 26

[Unattributed article: "Therapeutic Grafting of a Gene on a Child in Paris"]

[Text] Paris—For the first time in France, a team of French physicians and researchers of the Necker Hospital in Paris has grafted a missing gene in a young girl suffering from a severe and rare immunodeficiency.

To implement this gene therapy, the physicians grafted bone-marrow stem cells, genetically modified so they would continuously produce the missing enzyme, adenosine deaminase (ADA). (Bone marrow uses stem cells to manufacture blood cells such as red and white corpuscles.)

This recourse to stem cells, which can reproduce while transmitting the right gene, aims to achieve a final cure without having to repeat the injections of modified cells, as is the case when mature cells are used; however, according to Professor Alain Fisher, head of the team that developed this gene therapy, the intervention is "much too recent to tell." It will be necessary to wait "over six months" to know the results.

Unit 132 of the National Health and Medical Research Institute [INSERM], headed by Professor Fisher, received this year the authorization of the Ministry of Research genetic commission and the local committee for the protection of individuals. In March, the Hospital Necker department indicated that it would attempt this "French premiere" in gene therapy on two children, a boy and a girl aged 4 and 5.

In the laboratory, the gene is introduced into blood cells that are then reinjected into the patient. The French team worked in collaboration with the Dutch team of Professor Dinko Valerio (TNO Institute, Rijswik, The Netherlands), who proved the innocuousness of the method.

Worldwide, the first two attempts were undertaken on young girls in 1990, by the team of Professors Michael Blaese and French Anderson of the National Institute of Health (NIH, United States), using mature blood cells—modified lymphocytes—but still retaining a replacement medical treatment, the so-called Peg-ADA treatment, and repeating the injections of modified cells.

Since the stem-cell selection technique seems to be effective, Mr. Blaese's team decided to turn to this method to achieve a final cure of the deficiency. In Milan, another team attempted a gene therapy associating the grafting of lymphocyte and modified bone-marrow stem cells. The goal of these treatments is to enable the children to leave their sterile protective environments (their "bubbles") and lead a normal life.

Germany Growing Genetically Modified Vegetables

93WS0472E Paris AFP SCIENCES in French 22 Apr 93 p 34

[Unattributed article: "First Genetically-Modified Potatoes and Beets Grown in Open Fields in Germany"]

[Text] Berlin—On 15 April, for the first time in Germany, the Federal Health Department (BGA) authorized growing genetically modified potatoes and beets in open fields; ecologists immediately raised a protest.

In a communique, the BGA indicated that it had asked the Berlin Biotechnological Research Institute to carry out experiments on beets and potatoes grown in open fields in Wetze (central Germany) and Oberviehausen (Bavaria). The genome of the beets was modified to make them resistant to a root disease. Two kinds of potatoes will be grown to serve as industrial raw materials: one kind produces a special type of starch, the other kind develops larger tubers.

The experimental fields will be surrounded by signs indicating that the plants are not fit for consumption. "No detrimental impact on man, the fauna, and the flora is to be feared," the BGA indicated; but the Federation of Environmental Protection Associations [BUND] immediately raised a protest against the experiments. "The pollen from genetically-modified potatoes can contaminate other plants," Mr. Andreas Krug stated. This would present "countless risks for man and the environment."

Germany: Max Planck Institute Develops Photosensitive Biofilm

MI2806131293 Bonn DIE WELT in German 27 May 93 p 9

[Article by Michael Simm: "Protein Replaces Silver Salt: Films and Data Stores From High-Tech Biological Material"]

[Text] For 3,000 million years they have been swimming on our planet in concentrated salt solutions and thriving under conditions other organisms avoid like the devil

shuns holy water: halobacteria, as they are called, tiny crimson single-celled organisms that will now supply a film material whose properties send researchers and engineers alike into raptures.

Long before the first algae appeared, halobacteria "invented" photosynthesis and began to convert sunlight into energy. While man today tries to mimic this trick with solar cells made from silicon, halobacteria convert energy using a protein in their cell membrane known as bacteriorhodopsin. It is a highly complex molecule, the discovery of which earned German scientists Hartmut Michel, Johann Deisenhofer, and Robert Huber a Nobel prize back in 1988.

But now bacteriorhodopsin has advanced to become a high-tech material and is about to replace the silver salts used in films. This molecule can not only be used to make films that can be exposed and erased again at will, but it could also store more data in a smaller space than all the materials used to date. The famous Max Planck Institute considers the biofilm extremely significant—it could be as important for optical image and information processing as the development of the light-sensitive silver coating once was for conventional photography.

Initial trials showed the bacterial protein to be extremely durable: It does not age, it does not decay, and it always reacts in the same way to incident light, namely by changing colour from violet to yellow, up to about 100 times a second. If the molecular light converter is placed between two glass plates, it forms what may well be a record-breaking biofilm capable of storing up to 5,000 lines a millimeter.

The development of the revolutionary material has now been signled out for the Philip Morris Research Prize. Professor Dieter Oesterhelt of the Max Planck Institute of Biochemistry in Martinsried shares the 50,000-German marks prize with Professor Christoph Braeuchle and Dr. Norbert Hampp, who both work at the Institute of Physical Chemistry at Munich University.

Netherlands: Seed Company Develops Virus-Resistant Tomato

BR0806151793 Amsterdam RESEARCH PLUS RESULTS in Dutch May 93 pp 12-14

[Article by Bas Streumer: "Virus No Longer Threat to Food Crops—Tomato Plant Resistance Guaranteed by Genetic Engineering"]

[Text] If the biologists at Zaadunie, [a Netherlands] company in Enkhuizen, and the Agricultural University in Wageningen have their way, Mediterranean tomatoes, peppers, and lettuces will soon be less prone to the chocolate spot virus. This virus is transmitted by thrips, an extremely damaging fly which destroys hectares of these food crops in countries around the Mediterranean every year. Now, a virus-resistant strain is being developed by implanting some of the hereditary material from the virus into, e.g., a tomato plant. This will put an end to the enormous losses which have been incurred.

A few years ago, the Zaadunie realized that thrips posed a potential threat to tomato, pepper, and lettuce plants in southern Europe, to name but three examples. Dr. Schram, plant biotechnology manager at Zaadunie BV, comments: "We make most of our money by selling tomato, pepper, and lettuce seeds to southern Europe. For a plant breeding company, the logical consequence is to try and make these strains resistant to the virus. We are trying to use natural resistance sources, crossing them with a commercial variety."

The thrips which transmit the virus are found worldwide, but prefer a hot, damp environment. The fly pierces the plant to obtain food and, in so doing, infects the crop with a virus, causing the plant to die or produce no more fruit. Netherlands greenhouse growers have their hands full, but there are other ways of combatting the thrips. The fly has already built up resistance to several chemical agents, so another solution had to be found. "There are no or virtually no natural sources of resistance to this viral disease," said Schram, "and the scarce resistance which can be found in nature is very often based on several pieces of genetic information, spread throughout the genome—the genetic material contained in the nucleus of the plant. This does not make things any easier."

"We had to come up with something new. The Agricultural University in Wageningen seemed to have extensive experience with the insect and the virus at a fundamental, scientific level."

However, the university was not that familiar with the molecular biology of the virus. The problem had been identified, but its structure was still unclear. Zaadunie knew about the virus's field of infection and also how to introduce new hereditary information into the plant. "We entered into an agreement with Professor Goldbach's Virology Research Group to tackle this problem together," said Schram. "We would approach it from the practical viewpoint, and they would adopt a more fundamental approach. First, we characterized the virus; then, we developed a resistance mechanism." The research team assumed that the virus first had to be characterized. The theory was that the virus's hereditary material had to be closely examined and that elements of it had to be isolated. These would then be introduced into a plant. It was assumed that when the virus penetrated the modified plant, it would no longer multiply and the infection process would be stopped. If this succeeded, it would mean a breakthrough in seed technology, possibly resulting in patent applications for this group of viruses.

Subsidy Scheme

Developing this hypothesis involved substantial risks. Zaadunie therefore approached STIPT [Organization for the Implementation of Technology Policy], now renamed SENTER, and was awarded a grant via the PBTS [Program for Company-Oriented Technology Promotion] scheme. The project was launched in 1988 and formally completed last year. "This cofinancing enabled us to test our ideas rigorously. The most important aspect of the PBTS scheme is the boost which makes it easier to get over the first

hurdle. Companies always shy away from high risks. Otherwise, we would have started the project, but only much later, and probably on a much smaller scale. It is questionable whether it would then have had such a positive effect. The point is, quite simply, that speed is of the essence." Schram is highly impressed by SENTER. "It is an excellent group—one of the government bodies with which it is a pleasure to cooperate. The people running the PBTS scheme are flexible, approachable, and efficient. You can really tell them what you feel because the information is treated as confidential. In 1989, we launched another project for which we received a PBTS grant. We will probably finish that project quite soon. We have developed detection techniques which enable an improved and more rapid distinction between taste, odor, color, and nutritional elements and their quantities in food crops. This will enable plant breeders to produce high-quality products more efficiently."

Positive Results

Zaadunie and the Agricultural University got down to work, experimenting on tobacco, rather than the tomato plant. "The virus is also a major problem in the tobacco plant," says Schram. "Tobacco is an ideal plant for biotechnological research because it grows quickly and easily." A particle of hereditary material from the thrips virus was introduced into the tobacco plant. The hypothesis proved to be right on target. Schram continued: "We have built into the plant genome the very portion of the genetic information which the plant needs to continue living. The tests met our expectations. The plant hardly ever became diseased, if at all."

Now, the new technique has to be applied to crops in which Zaadunie is interested. The tomato plant was the first to be considered, and the concept seemed to work there, too. The virus-resistant tomatoes are now proudly on display in the greenhouses.

Legislation

In the Netherlands, experiments with genetic engineering cannot be carried out at the drop of a hat. The Ministry of Housing, Physical Planning, and the Environment has formed a committee (the Provisional Genetic Engineering Committee (VCOGEM) which informs the ministry whether licenses are being awarded for genetic engineering, stating the conditions attached to such awards. At present, genetically modified plants may not, for the time being, be eaten by men or animals. As a result, the tomatoes cannot be consumer tested. "In the Netherlands, the tomato cannot be eaten unless we apply for a license from the VCOGEM to perform this type of experiment," said Van Grinsven. About the taste, he said: "I do not expect the tomato to taste any different. The little extra bit of genetic information does not affect the taste."

In the Netherlands, the Leiden-based biotechnology company Mogen NV is taking the legal steps required to market their modified potato, which is resistant to a different virus from the transgenic Zaadunie tomato.

The way in which the Netherlands law awards Mogen licenses to market its transgenic potato (a precedent in the Netherlands for a transgenic food crop), is an important test case for the agricultural industry. If the transgenic seeds are allowed to enter the market, Zaadunie believes that Mediterranean farmers will welcome them with open arms. They have visions of fields covered in plants no longer threatened by the dreaded virus.

COMPUTERS

Germany: Information Processing Enhanced by Virtual Reality

93WS0391C Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 11 Mar 93 p 8

[Unattributed article: "Virtual Reality Makes Developments Graphic: Demonstration Center Will Help Mid-level Users in Application"]

[Text] Frankfurt—The Fraunhofer Society has established a center for the demonstration of virtual reality. Participating in this installation, which is the only one of its kind in the world, are the Fraunhofer Institute IAO [Labor Management and Organization], IBP and IPA [Production Engineering and Automation] in Stuttgart as well as the IGD in Darmstadt. The Fraunhofer Institute for Graphic Computing (Demonstration Center for Virtual Reality, Dr. Martin Goebel, Wilhelminenstr. 7, 6100 Darmstadt/ Fax: 06 151-155-199) maintains a local presentation, information and learning center especially for smaller and mid-size businesses.

Virtual reality marks a new possibility for understanding between man and machine. The user can by means of monitor goggles and data gloves directly experience the information which is contained within the computer, "access" rooms and influence directly and intuitively the objects and actions pictured therein. The area of virtual reality does, however, put extremely high demands on hardware and computational algorithms to make it possible to present apparent worlds optically, acoustically and tangibly in real time.

Such procedures are already being used commercially today to demonstrate and evaluate construction plans. Architectural, city and infrastructure planning can thereby be made more graphic. Virtual reality may help in interior design as well as with the conceptualization of a product and the production plan. Interesting areas of application in the future will be teleoperation in medical technology as well as visual, driving and training simulation.

The demonstration center is to serve as a starting place for questions dealing with the practical application of virtual reality. Here, the techniques and example applications are to be based on scientific technique and shown in practical application.

In summary, in addition to technical advice, the services offered by the center also include training exercises, making the infrastructure available for presentations. Also offered are plans for and implementation of user seminars,

feasibility and application studies as well as equipment and systems tests. Furthermore, the center is involved with data modelling and conversion as well as with the development of special solutions in the area of virtual reality.

Germany: Neural Computing Center Founded at Ruhr University

MI0406031093 Bonn DIE WELT in German 22 Apr 93 p 7

[Article by Norbert Lossau: "Theory Will Now Become Practice—Neural Computing Center Opened at Bochum University"]

[Text] North Rhine-Westphalia Science Minister Anke Brunn is happy to go on video both with and without glasses to demonstrate the efficacy of a computer system developed by Bochum scientist Professor Werner von Seelen. If an image of a person is recorded on the system by videocamera, the system can later identify the same person from a large file of faces—even if his or her facial expression, hairstyle, or perspective have changed. Frau Brunn smiled, and the computer recognized her just the same.

The demonstration was given earlier this week during the official opening of the new Neural Computing Center attached to the Ruhr University in Bochum. Together, its two directors, Professor von Seelen and Professor Christoph von der Malsburg, intend to attempt to convert existing neural computing know-how into marketable products on the strength, they hope, of commissions from industry. The above facial recognition system, for example, could be used to identify different components on assembly lines.

The two neural computing experts in Bochum are developing "intelligent" computer systems, modeled on the functional principles of biological nervous systems. Such systems, also known as neural networks, are capable of learning and adapting flexibly to new situations. The applications of this technology range from "sighted," adaptive robots to systems that can identify cancer cells on their own.

"The aim of the new Neural Computing Center is to convert knowledge derived from basic research into practical applications," said the minister. This is the very area in which Germany has so far been remiss: Though a great deal of research into neural networks is taking place here, most marketable products using this promising technology come from the United States.

A 12.4-million German mark [DM] financial boost has been provided to set the new institute on its feet, and a futher DM10 million have been contributed to date by third parties. Occupying a 700-square meter site, the new research center will eventually employ between 40 and 50 researchers working on the development of neural networks.

So far, however, it has only five scientists, who are working on the PROMETHEUS [Program for a European Traffic System With Highest Efficiency and Unprecedented Safety] research program funded by the Federal Research Ministry, which is developing systems for automatic passenger car steering on highways.

The research workers in Bochum are also engaged on another project on "intelligent" computerized evaluation and processing of medical images, such as X-ray photographs. Last but not least, they are developing a neural control system for a plastic mill line designed to ensure optimum quality for the plastic products manufactured.

Swiss Develop ASIC Chip for Rapid Data Encipherment

93WS0468A Zurich NEUE ZUERCHER ZEITUNG (INTERNATIONAL EDITION) in German 12 May 93 p 45

["The Fastest Encipherment Chip"]

[Text] Ever since antiquity, information that had to be kept secret has been transformed or encoded so that it could only be read by the intended recipient. Even today's modern communications companies must take care so that information intended for a specific telephone subscriber can be heard by him alone and no one else. Computer data as, for example, that generated in the banking industry is transmitted on a daily basis and must likewise be protected. When one considers that today up to 30,000 telephone conversations are easily transmitted over a single glass fiber cable, it is clear that sender encoding or encipherment as well as receiver decipherment security is extremely important.

Every bank customer naturally assumes that his account data is protected and secured when transmitted. Thus, cryptography lives on in modern communications systems. The work and responsibility of the erstwhile cryptographer has been taken over by large-scale integrated circuits. They are far more efficient than any human code specialist in enciphering and deciphering data flows. In recent years, the method of the so-called Data Encryption Standard has been used for encipherment, although the system has many disadvantages. For example, it is too slow, no longer absolutely secure, and in addition is subject to certain U.S. export controls.

The Institute for Integrated Systems at the Zurich Technical University has developed a large-scale integrated circuit, designated VINCI. It is a 9.9 x 11 mm edge-length chip, considered to be the fastest and most secure encipherment chip in the world. The chip can encipher or decipher up to 5,000 pages of typed text, up to 6,000 telephone conversations simultaneously or television pictures (with sound) per second. It operates at a working frequency of 25 megahertz with an encipherment or decipherment rate of 178 million bits per second. The operator can choose between simpler or more complicated encipherment modes. This new encipherment process on which the chip functions is called IDEA (International Data Encryption Algorithm) and was developed after years of research at the University's Institute for Signal and Information Processing. To date, it has withstood every attempt to break the encipherment code. The unusually high processing performance from a single chip indicates

great complexity. In an area of 108 mm^2 VINCI contains about 251,000 transistors. It is the best application specific integrated circuit [ASIC] designed in Switzerland to date. However, it had to be produced outside the country because the requisite facilities are not available in Switzerland. VINCI has a self-testing capability that can yield an evaluation of the "state of its health," i.e., its ability to function, within 160 millionths of a second. In addition, VINCI can ascertain any operating failure and report it immediately, e.g., by means of a warning light or on a test monitor screen.

Applications

The new chip can be used where and whenever high data transmission rates are required as, for example, in banking transactions from affiliates to the main office, from automatic tellers, from automatic service station cashiers to the central computer, from the stock market to the stockbroker, and in telephone, E-mail, or fax communications. The use of this rapid and efficient en use can also be safely predicted in multimedia operations, where picture, sound, data, and graphics must all be transmitted simultaneously.

DEFENSE R&D

France: Thomson To Develop Night Firing Antitank System

BR2406102293 Paris LA LETTRE DU GIFAS in English 3 Jun 93 p 2

[Unattributed report: "Thomson TRT Defense Developing Night Firing Capability for the Short-Range Franco-Canadian Anti-Tank System Eryx"]

[Text] Aerospatiale, prime contractor in the Franco-Canadian short-range anti-tank weapon system Eryx, has notified Thomson TRT Defense of a research and development contract for the Mirabel thermal image unit which will make the Eryx a night firing system.

The contract acknowledges the know-how and experience of Thomson TRT Defense in night vision associated with fire guiding systems. Thomson TRT Defense is already prime contractor for the Mira thermal sight equipping the Milan anti-tank system. It also supplies the Victor thermal camera of the Hot anti-tank system carried by the Gazelle helicopter and the Castor camera for the fire guiding systems of tanks and firing systems for the short-range missile Crotale NG [new generation].

In the Mirabel research and development program, Thomson TRT Defense is cooperating with the Canadian firm Allied Signal Aerospace of Canada. This consolidates the close cooperation which started between the firms in 1989. The Mirabel thermal image unit is designed for lightness, compactness and versatility. The large production will do much to bring costs down. Other versions are being offered for many other applications, from very-short-range anti-air fire guiding to fire guiding for light armoured vehicles.

France: PACEO I and II Military Components Programs Reviewed

Fr800 Million per Year Spent on Military Components

BR2306130093 Paris ELECTRONIQUE INTERNATIONAL HEBDO in French 10 Jun 93 p 20

[First in a series of six unattributed articles on the French PACEO I and II military components programs: "Fr800 per Year for French Military Components"]

[Text] Despite the budgetary restrictions imposed on all organizations within the Ministry of Defense, electronics—and electronics components in particular—remains a strategic axis for the General Armaments Directorate (DGA). The sums at stake are considerable: Of the 116 billion French francs [Fr] in defense budget program authorizations for 1990, 28 percent was earmarked for electronics and information technology.

The Directorate of Electronics and Information Technology (DEI) alone manages an annual budget of Fr5 billion. Among other things, the directorate is responsible for managing an electronics and optronics action program (PACEO [Action Program for Electronic and Optoelectronic Components]) with a budget of Fr2 billion. Between 1992 and 1996, this Fr2-billion program will focus only on downstream research (if upstream research carried out by the DRET [Directorate of Research, Studies and Technologies] were to be included, the components budget would come to approximately Fr3 billion).

For pure research programs as a whole, the DGA spends Fr700 to 800 million per year on electronics components. This does not include developments meeting specific systems needs.

Defense Ministry Launches PACEO II Program

BR2306130893 Paris ELECTRONIQUE INTERNATIONAL HEBDO in French 10 Jun 93 pp 20-21

[Second in a series of six unattributed articles on the French PACEO I and II military components programs: "Defense Components Plan: Second Phase Launched"]

[Text] The [French] Ministry of Defense attaches "vital" importance to components. This is translated into funding, organizations, and technological choices, especially in the context of a "components program" known as PACEO [Action Program for Electronic and Optoelectronic Components], of which phase II has recently been launched.

The last interministerial French "integrated circuit program" (involving the Ministries of Industry, Research, Defense, and Telecommunications) ended in 1986. Since then, each ministry has been running its own program, depending on its specific interests. (This does not prevent an Interministerial Working Party on Components (GTIC) from meeting occasionally to avoid any redundancy in the actions being taken. There are also meetings on specific topics between the Defense Ministry and the EDF [French

Electricity Company], the ministry and the CNET [National Center for Telecommunications Studies], etc.)

This is how, in 1987, the [Ministry of Defense's] General Armaments Directorate (DGA) came to launch an "action program for electronic and optoelectronic components," known as PACEO I, which ran until 1991. Its aim was to enable French manufacturers working in the defense sector to source the basic technologies that were essential for their work in France. The DGA therefore listed all the component technologies which they might need, either in order to manufacture the best systems in the world or to guarantee them an independent supply. Then it selected those technologies which were not already used in civil applications, with a view to taking specific action. Consequently, it comes as no surprise that military applications are today still "pulling" technologies such as analog GaAs [gallium arsenide] devices, top-of-the-line infrared detectors, silicon-on-insulator (SOI) substrates, surface acoustic wave (SAW) filters, and other MMIC's (microwave integrated circuits).

The PACEO I program was divided into four parts:

—Silicon integrated circuits, including the development of CMOS-SOI [complementary metal-oxide semiconductor] circuits, ASIC [application-specific integrated circuits] tools adapted to defense requirements, and standard circuits (essentially ADC/DAC's [analog-to-digital and digital-to-analog convertors]);

—Ultra-high frequency components, especially tubes, GaAs (for power or broadband applications) MMIC's, and discrete components (some passive);

—Optoelectronics, which covers infrared CCD [charge-coupled device] imagers and semiconductor power lasers (for pulsed laser pumping and telemetry);

—Finally, conventional vital components such as time-frequency devices (especially ultra-high-stability oscillators), some types of connector, specific capacitors (ultra-high or high-energy), and fuel cells.

Developing Tools

This program produced very tangible results. It was therefore decided to relaunch it to cover the period 1992-1996. The new program, PACEO II, was adopted by the Ministry of Defense in December 1992. It differs from the previous program notably by the withdrawal of the DRET [Research, Studies, and Technologies Directorate of the Defense Ministry] (upstream research), which is now pursuing its fairly exploratory activities independently of PACEO (the STEI [Electronics and Computer Technical Service], now solely in charge of the latter program, nonetheless gives its opinion on the upstream research to be conducted). Another difference is that a fifth area of research has now been added to the previous four, namely a "specific interconnection" strand, covering integrated circuits encapsulation, packages, substrates, surface mounting technologies, and, to a lesser extent, materials. Without careful interconnection, systems cannot perform as they should—a fact which has to be borne in mind. It is worth noticing that 95 percent of STEI's activities concerning components are now run within PACEO II and that this PACEO program covers neither microprocessors nor ASICs. This is not unusual: The defense industry does not need a microprocessor which can both meet several of its requirements and is not commercially available. The same applies to the ASICs: PACEO aims to supply some tools to design certain types of ASIC, but not the ASIC's themselves.

Budget of French Defense Components Program (percentages rounded off)

	PACEO I	PACEO II
Digital and linear IC's	40 percent	40 percent
Hyperfrequency components	30 percent	25 percent
Optoelectronics and optronics	20 percent	20 percent
"Conventional" components	10 percent	5 percent
Interconnection and energy	-	10 percent

PACEO 1 1988-91 budget: Fr3,136 million

PACEO 2 1992-96 budget: roughly Fr2,000 million (excluding upstream research)

PACEO I Produces 'Hardened' Components, Cell Libraries

BR2306131493 Paris ELECTRONIQUE INTERNATIONAL HEBDO in French 10 Jun 93 pp 23-24

[Third in a series of six unattributed articles on the French PACEO I and II military components programs: "Integrated Circuits: Priority Given to 'Hardened' Circuits and Libraries"]

[Text] With respect to integrated circuits, of prime importance to the arms industry is, on the one hand, that the technology is resistant to radiation and, on the other, that highly specific cell libraries are available which guarantee compatibility from one generation of technology to the next.

One of the main results of PACEO I [Action Program for Electronic and Optoelectronic Components], which ended in 1991, will have been the development of a 1.2-micron CMOS-SOI [complementary metal-oxide semiconductor—silicon on insulator] technology for integrated circuits which can operate under nuclear (gamma, neutron, X-ray, etc.) radiation. This is what is termed a "hardened" technology. Several years ago, the French Army actually decided to abandon SOS (silicon on sapphire) technology at research level, although it is still being used by Thomson-CSF Specific Semiconductors (TCS), and refocus on SOI technology, which could be more attractive in terms of costs and yield.

PACEO I not only showed that SOI technology offered the same level of hardness as SOS technology, but also that,

since it was close to civilian technologies, there was every reason to hope that it would follow the trend toward increasingly higher integration levels (in Britain, GEC Plessey is still making improvements to 1.5-micron SOS technology). By the end of the PACEO II program, it is envisioned that TCS will have three-layer metallization 0.8-micron CMOS-SOI technology which offers the same performance as 0.8-micron CMOS technology on solid silicon (usually, SOI produces a 30-percent increase in performance, compared to solid silicon, but the limits imposed by the hardening performance offset this advantage). The substrate is provided by Soitec, which uses the Simox process developed by the LETI [Electronics and Information Technology Laboratory].

Within the context of PACEO I, several circuits have been produced using SOI technology—primarily a 16-bit 29101 microprocessor resistant to 1 Mrad, a 64-K SRAM [static random- access memory] with access times of from 55-ns to 70-ns resistant to 400 krad, and an 0.45-W, 20-MHz 8-bit A/D [analog-to-digital] converter resistant to 1 Mrad. A library with 153 cell types and single- and dual-port RAM [random-access memory] or ROM [read- only memory] type macrocells has been compiled.

Highly Specific Cell Library

Arms manufacturers have highly specific requirements regarding ASICs [application-specific integrated circuits]: Designs have to be developed quickly and be right first time; it must be possible to keep on making the products irrespective of future technological upgrades; and some specific functions relating to signal processing and A/D conversion, in particular, have to be available in a cell library. However, with production runs generally on the small side, there is no need to optimize the size of the chip.

State-Of-The-Art A/D and D/A Converters

The decision to work with a commercial compiler was made in 1987 (Mentor) for current CMOS circuits. A library of 30 macrofunctions whose parameters can be adjusted "in every direction" (known as CSAM) was therefore put together as part of PACEO I for three-layer metallization 0.8-micron CMOS technology and has now been ratified. This library is currently supplied by TCS. As part of PACEO II, four-layer metallization 0.5-micron technology will be approved (in 1994), together with its 0.8-micron compatible library. The Electronics and Computer Technical Services (STEI) division of the General Armaments Directorate (DGA) confirms that this library is currently "state-of-the-art" at world level. Efforts will be continued in this area as long as there are no commercially available libraries that can offer all the desired functions, especially central processing units and DSP's [digital signal processors].

SGS-Thomson and Matra MHS are offering a compatible CMOS technology for which libraries have already been developed.

PACEO I also developed linear gate-array circuits in bipolar silicon technology with cut-off frequencies of 8 GHz (for circuits operating at up to 1.2 GHz) and with a complexity of up to 2,572 components, as well as a mixed analog-digital cell library in CMOS technology adapted to linear circuits.

Another important area of activity in silicon integrated circuits is that involving A/D and D/A converters. Again as part of PACEO I, 200- and 500-MHz 6-bit converter circuits have been produced with bipolar technology peripherals (the same technology that was used before), as well as a 0.33-W, 20-MHz, 8-bit circuit (MP-7684- compatible) using CMOS technology. A second—again monolithic—series covers 50- to 300-MHz, 8-bit models in bipolar technology and 0.7-W, 20-MHz, 10-bit models in CMOS technology. A third, hybrid series comprises several 12-bit models up to 10 MHz and 4.5 W.

PACEO II will involve the development of monolithic converters which will gradually be based on BICMOS [bipolar CMOS] technologies with SOI variations. The fastest of these circuits will be a 1-GHz, 8-bit converter. Other low-consumption models will cover the 12-bit 20-MHz, 14-bit 30 MHz, and 10-bit 20 MHz ranges of hardened components. Twelve-bit 20- or 30-MHz cells will also be developed for the mixed library.

It should be stressed that PACEO I also included a special memories section, entrusted to Matra MHS, which has resulted in the development of dual-port 2K x 8, 4K x 16, and 8K x 8 RAM's and 1K to 8K x 9 FIFO [first in, first out] memories with access times of between 25 and 55 ns, depending on the model.

PACEO Develops Low-Noise Power GaAs MMICs

BR2306135593 Paris ELECTRONIQUE INTERNATIONAL HEBDO in French 10 Jun 93 pp 24-25

[Fourth in a series of six unattributed articles on the French PACEO I and II military components programs: "Components Remain Basis of French Defense—Gallium Arsenide Components: Cost Reduction a Priority"]

[Text] The goal of research on microwave components used to be improved performance only. Now, an additional aim is the reduction of costs and development times of new models.

Among all microwave components for which improved performance is being sought, the highest priority goes to GaAs [gallium arsenide] monolithic microwave integrated circuits (MMIC's): On such circuits will hinge tomorrow the cost/performance ratio of on-board radars, countermeasure devices, homing heads, satellite links, microwave links and, generally speaking, all communications, navigation, and identification systems. As part of PACEO I [Action Program for Electronic and Optoelectronic Components], two technologies have been developed and are now in the production phase: one low-noise technology and one power technology. The low-noise circuit includes two versions: one in 0.5-micron technology which makes it possible to manufacture circuits that operating at speeds of up to 18 GHz [gigahertz] a 2- to 18-GHz amplifier has

already been made); the other in 1-micron technology will also be able to produce a "certain amount" of power.

Up to 20 GHz With a 0.5-Micron Technology

As regards power MMICs, a 0.7-micron technology makes it possible today to manufacture circuits that operate at up to 10 GHz, while a 0.5-micron technology produces circuits with a 20-GHz limit.

As part of PACEO II, the low-noise technology will reach the 20-GHz mark, but, more importantly, two new MMIC technologies will be established: one "very-low noise" technology leading to 40-GHz circuits and one "high-power" technology for 20-GHz circuits. PACEO I has already resulted in the manufacture of 20-Ghz GaAs power transistors.

Among other things, these programs made it possible to build a demonstration unit of emission module for on-board scanning radars called Cobra. The module delivers 3 Watts in the C band via 6 circuits. Since a radar has several hundreds of such modules, their price should ideally go down to 5,000 French francs [Fr] per unit. This is far from being the case now.

Silicon and Tubes Not Neglected

As regards silicon transistors, PACEO I resulted in the development of units with the following specifications: 900 watts at 1,030 MHz (Navaids); 350 watts at 1,200-1,400 MHz (L-band radars) and 110 watts at 2.7-2.9 GHz (S-band radars). As part of PACEO II, further work should be done on this last application.

In the field of microwave tubes, PACEO I made it possible for Thomson DTE [Electronic Tubes Division] to implement a modular approach that reduces design times and manufacturing costs of TWTA's [traveling-wave tube amplifiers]. As a result, developing a new TWTA now only takes 14 to 22 months, as compared with two to two and a half years in 1987, and development costs have been slashed by a factor ranging from two to five depending on the model. This approach was implemented in the RBE2 [Dual-Plane Electronic-Scanning Radar] radar of the Rafale [fighter aircraft] as well as in the RAC attack radar of the SDC [Siemens Distribution Center] project. All C-, X-, Ku-, and Ka-band applications are now covered. In the PACEO II program, priority is still given to cost and size reduction as well as band expansion (for electronic warfare applications).

Among other developments in microwave components, the most important ones pertain to Tekelec Airtronic's PIN [positive-intrinsic-negative] diodes (20- to 50-percent cost reductions achieved under PACEO I).

[Box]

General Armaments Directorate's Activities in Microwave Components

MMICs, especially gallium arsenide ones, represent the main focus of the DGA/STEI [General Armaments Directorate/Electronics and Computer Technical Service] in the field of microwave components:

Diodes: 5 percent

Tubes: 15 percent

Miscellaneous: 12 percent

MMICs: 68 percent

PACEO Develops High-Performance Infrared Detectors

BR2406100593 Paris ELECTRONIQUE INTERNATIONAL HEBDO in French 10 Jun 93 p 25

[Fifth in a series of six unattributed articles on the French PACEO I and II military components programs: "Infrared Technology: Toward Inexpensive 128 x 128 Detectors"]

[Text] The greatest achievements of the PACEO [Action Program for Electronic and Optoelectronic Components] programs are to be found, among other fields, in infrared detection: The detectors made by the Sofradir company are rumored to boast the best performance worldwide.

In infrared detection, the PACEO I program will have led, among other things, to the development of 288 x 4 detection arrays made of HgCdTe [mercury, cadmium, tellurium], the only material that allows efficient operation at wavelengths of up to 12 microns (for high-performance detection of objects at ambient temperature). However, for optimal operation, such detectors must function at a very low temperature (70 Kelvins), which requires very costly mechanical cooling devices (Stirling). As part of PACEO II, the focus is mainly on two directions: First, increasing detector complexity, in particular, making 128 x 128, 3-5 micron, 77 Kelvin retinas and 576 x n, 8-12 micron, 77 Kelvin connectable arrays (in order to build complex devices). Second, developing reliable but less sensitive devices which would operate a temperature of 200 Kelvins.

It will thus be possible to cool these detectors, in particular the ones with a 128 x 128, 3 to 5-micron retina, by means of a Peltier-effect cell (no moving part), resulting in a substantial cost reduction. For such infrared applications, there is still no question of using other materials, as the performance they yield is considered unsufficient. In the optoelectronics area, PACEO I has also produced 6 x 6-inch and 6 x 8-inch LCD [liquid crystal display] screens for avionics applications, 1.3-micron broadband optical microheads (4 GHz), 0.8-micron LEDs [light-emitting diodes], and 1.3-micron PIN diodes. PACEO II will lead to "super-light-emitting" LEDs as well as a 1.3-micron receiver with connector for military applications.

In the field of semiconductor power lasers for solid-state laser pumping, PACEO I also raised peak power from 500 mW [milliwatts] for a diode in 1986 to 60 W for arrays or even 300 W for stacked arrays in 1991. PACEO II aims at making plates that emit on a perpendicular rather than parallel plane relative to the surface, in order to transmit a peak power of 1 kW from 1 square centimeter of monolithic material.

[Box]

General Armaments Directorate Activities in Optoelectronics

Infrared technology remains the driving force for innovation in military object- and shape-detection devices:

Display components: 18 percent

Optoelectronic components: 3 percent

Power laser diodes: 6 percent

Infrared detectors: 73 percent

PACEO: Miscellaneous Technology Developments

BR2406101093 Paris ELECTRONIQUE INTERNATIONAL HEBDO in French 10 Jun 93 pp 23, 24, 25

[Sixth in a series of six unattributed articles on the French PACEO I and II military components programs; this item consists of six boxes describing miscellaneous technology developments]

[Text]

[Box, p 23]

Oscillators: Toward Better Stability Than 10^{-13}

As part of PACEO I [Action Program for Electronic and Optoelectronic Components], projects involving CEPE [Electronics and Piezoelectricity Company], CQE, and Tekelec Systemes led to the creation of bulk-wave oscillators-resonators which yield frequency stability levels ranging from 10^{-12} to 10^{-13} and are useful for synchronizing terrestrial equipment with a submarine's electronic systems, for example. PACEO II's objective is to increase this stability by a factor of five, to miniaturize the oscillators, and manufacture them in SMC [surface mounted component] packages. How can this be done? Among others through an increase in materials purity, better control, and better compensation....

[Box, p 24]

Component Packaging for Military Applications: The Day of Plastic Has Come

Because it is much cheaper to package integrated circuits in plastic rather than ceramics, the armed forces could not remain indifferent to this solution, even though, in their eye, the behavior of plastic over time as well as under high temperatures was never very credible. However, an assessment process of resins used in civilian applications was launched as part of PACEO I. How can aging be simulated? How can the formulation of resins—as well as their impact—be monitored? Is it possible to forecast accurately and entirely a given resin's behavior in a difficult environment? The PACEO I program began to answer these questions and, since the first results were positive, the process is now continuing as part of PACEO II.

[Box, p 24] Within the scope of the PACEO II program, the firm Egide has developed package types for 200-MHz [megahertz] signals and Xeram has focused on integrated circuit packages with up to 500 input/outputs.

[Box, p 25]

Higher Density Connectors For Military Applications

As part of PACEO I, Air LB, Amphenol, Deutsch, FCI [Framatome Connectors International], and Radiall participated in programs on connectors aimed at substituting, in cylindrical models, metal with weight-saving composite materials and at integrating filters in the packages. For printed circuit connectors, the aim was to increase the number of pins. Under PACEO II, the goal is to increase density and to develop integrated shielding and standardization, in particular for 2-millimeter-pitch devices.

[Box, p 25] Studies on lithium accumulators have been initiated as part of PACEO II with a view to solving problems of operation at low temperatures, under hazardous conditions, and improving the number of charge/discharge cycles. SAFT [Traction and Fixed Accumulators Company] and Sorapec are participating.

[Box, p 25]

Substrates: Almost Unlimited Choice

The PACEO I program led to the development of cosintered high-temperature substrates by Xeram and thin multilayer polyimide substrates by Thomson Hybrides. Research concerning the former has been suspended under PACEO II, while the latter are further being perfected with a view to specific applications. Generally speaking, PACEO II's objective is to increase density at lower cost levels, whatever technology this may take. Future development priorities have not been identified yet. They may include low-temperature cosintered substrates as well as aluminum nitride substrates for power circuits.

With regard to interconnection technologies, substantial efforts have been made under PACEO I on flip-chip technology, in particular by LETI [Laboratory for Electronics and Information Technologies]. However, due to the fact that standard circuits based on this technology are not available, PACEO II officials now choose the TAB [tape automated bonding] technology, even though it presents an industrial problem (TAB technology is normally adapted to large production runs). However, no major endeavor has yet been initiated with respect to TAB technology.

UK: Infrared Camouflage Systems Upgraded

BR1606141393 Toddington NEW MATERIALS INTERNATIONAL in English Jun 93 p 6

[Unattributed article: "Reflectometer Helps Hide Hot Bodies"]

[Text] Improved infrared camouflage should be the result of a contract awarded to SIRA [Scientific Instrument Research Association] by the Defence Research Agency, an Agency of the UK's Ministry of Defence, for an upgrade to

SIRA's bi-directional reflectometer, originally built for the Royal Arsenal at Woolwich in the early 1980s.

The reflectometer records infrared reflectivity. It can be used to design improved performance camouflage for vehicles, aircraft and personnel, or to test and develop infrared thermal imaging systems for defecting heat-producing equipment. Civil applications include quality control in the paint and pigment industries.

The new upgrade will introduce PC-compatible computer control to speed up both mechanical operation and data acquisition.

Greater flexibility will also result from using an industry-standard 8086 PC. When the upgrade is complete, the new software will provide access to the existing in-built data analysis functions or the means to export recorded reflectance data to analysis packages running on Windows and DOS operating systems.

The existing reflectometer is based on a U-man 68000 computer system. It is used to record both visual and infrared reflectivity of samples in the 0.4-12 micron wavelength range. The reflectometer operates over a wide angular range in elevation and through a full 360 degrees in azimuth. SIRA Ltd is at South Hill, Chislehurst, Kent BR7 5EH, UK. (Tel.: 081 467 2636)

ENERGY, ENVIRONMENT

France: Radioactive Waste Disposal Software

93WS0446B Paris L'USINE NOUVELLE/ TECHNOLOGIES in French 15 Apr 93 p 12

[Article by Thierry Lucas: "Radioactive Waste Management Software"; first paragraph is L'USINE NOUVELLE/ TECHNOLOGIES lead]

[Text] The program developed by Cap Sesa for EDF [French Power Company] manages the preparation, dispatch, and transportation of 30,000 radioactive parcels a year.

Managing the dispatch and storage of parcels is only a banal problem of logistics. However, when these parcels contain radioactive wastes from 20 French nuclear sites and are destined for storage centers that our descendants will inherit, the matter requires thought.

This is the role of the DRA program developed by Cap Sesa for EDF to manage all short-lived low- or medium-activity wastes. These wastes are the byproducts of maintenance work (rags, metal scrap, wood, and vinyl) and the process itself (e.g., the primary cooling circuit), but do not include nuclear fuel. DRA manages the production and dispatch of 30,000 parcels a year at two sites of the National Office of Radioactive Waste Management (ANDRA).

The system has two governing constraints: data reliability and waste traceability. It is based on the automatic exchange of information between the nuclear power plants and ANDRA. At each site, a PC-based local area network communicates with an IBM 3090 at EDF's Clamart computer center via a Transpac-based private network. The characteristics of each parcel are recorded to a data base at Clamart.

When a parcel is ready, the DRA user enters its characteristics and automatically transmits them to the ANDRA computer, which analyzes the information and either accepts it or rejects it, issuing an error message. The link between EDF and ANDRA (a dedicated line) is secured by a microcomputer, which acts as a gateway. If the parcel is validated, the user fills out a waybill, which triggers an acknowledgment of receipt from ANDRA.

Next July, a new version of DRA will include a portable-terminal-based bar code system designed to improve input reliability and parcel traceability.

France Publishes Radioactive Waste Inventory

93WS0480B Paris AFP SCIENCES in French 29 Apr 93 pp 26, 27

[Article: "ANDRA Publishes 'National Inventory of Radioactive Waste'"]

[Text] Paris—On 27 April, after more than a year of collecting and synthesizing data, the ANDRA [National Agency for Management of Radioactive Waste] published its first "National Inventory of Radioactive Waste." It includes the waste produced in the past as well as that being produced today, with their locations and current states.

This inventory is intended to facilitate "conservation and jogging of memory with regard to the dump sites" and "looking them in the eye so as to better manage them," said Mr. Henri Wallard, general manager of the Agency, during a press conference. Operating under a new status as an autonomous public agency, the ANDRA was made responsible, by the law of 30 November 1991, for listing the current state and the location of all radioactive waste in France.

"Ninety five percent of the nuclear waste is generated by the 'big producers' among the fuel cycle industries (COGEMA [General Nuclear Materials Company], EDF [French Electric Power Company], CEA [Atomic Energy Commission])," said Mr. Wallard. The 550 "small producers" (industries, hospitals, research centers), comprise the remaining 5 percent and are also criticized in the approximately 250-page document.

To carry out this project, ANDRA started out from existing inventories and conducted a supplementary inquiry among those responsible for the dumps (EDF, COGEMA, CEA), the other operators, and associations such as the CRITAD [Independent Regional Radioactivity Information Commission] and Environment Action. Collected over a period of 13 months by ANDRA's National Radioactive Waste Observatory, the information, covering 10 categories of site, was sorted into 139 files, classed by region and department.

The first section of the inventory deals with the waste currently being produced, whether by nuclear power

plants, fuel-cycle installations, laboratories, industries, or hospitals. The second section deals with the waste produced in the past, and stored in nuclear installations, mines, or old dumps such as those at Saint-Aubin and Bouchet (Essonne).

The rehabilitation work being done is also included. Also listed are several sites such as the Marie Curie laboratory at Arcueil and Highway A-87, under which 4,000 cubic meters of slightly contaminated rubble have been buried. The radiferous waste of the old Bayard alarm clock plant at Dieppe is also mentioned.

"It is important to avoid mixtures between highly radioactive waste, from nuclear power plants, for example, and slightly contaminated waste such as hospital bottles and smocks. All are entered in the inventory," Mr. Wallard indicated. "The philosophy of this very long-drawn-out and detailed inventory has been to enhance the voluntary diffusion of the information, inasmuch as, although available, it is not widely known. It is a reference and communication tool, and it will be updated annually."

Some 600 copies of the document have already been distributed to elected officials, local administrative agencies, and environmental protection associations. "Two thousand more copies are available, and anyone may come and consult our sources, contribute information, or comments," said the general manager.

This inventory includes only civil nuclear waste—except for the Pontailler-sur-Saone (Cote-d'Azur) site, where military waste is also stored—but "an inventory of military nuclear waste is currently under way," said Mr. Wallard.

For the time being, no radioactive waste has been inventoried in Corsica, in Franche-Comte, or in the DOM-TOM's [Overseas Departments and Territories]. But the exhaustivity of the inventory cannot be totally vouched for, inasmuch as this would require means of investigation greatly exceeding ANDRA's prerogatives. "Such additional prerogatives as would be required belong to the state," said Mr. Wallard. "It is therefore entirely possible," he said, "that 20 or 30 years from now, old dump sites, or old radioactive sources used, for example, in medicine, may come to be 'discovered.' The gendarme of the environment remains the state."

Mr. Michel Barnier, minister of the environment, for his part, indicated that the ANDRA inventory fulfills his ministry's "desire for transparency," and that his ministry will "rigorously and attentively" monitor the carrying out of the corrective measures necessary at some 10 dumps.

Italy: New High Temperature Process for Waste Disposal, Energy Generation Tested

93WS0485A Munich SUEDDEUTSCHE ZEITUNG in German 6 May 93 p 38

[Article by Christa Friedl: "A Blow for Independence for the Waste Business?"]

[Text]

A New Method is Said to Eliminate Trash Without Pollution and to Recover Energy in the Process

A new catchphrase is going around among German waste experts at this time: Thermoselect. This is the name of a method that converts any type of trash into a harmless glassy residue. If the claims of the operating company having the same name and headquartered in Fondotoce in Italy are believed, this takes place with virtually no pollution, without much waste gas or waste water and while recovering energy.

The promises of Thermoselect appear to be a blow for independence against the background of German waste reality. Existing trash incinerators are overloaded, new ones can scarcely be approved because of public objections. The same applies to trash dumps so that in five years every second West German community will not have dump space available. This is the prognosis of Hans Monninghoff, head of the Environment Department in Hannover. "For this reason, the need for a new, inexpensive and reliable method is extremely great."

Just how great is being demonstrated in Fondotoce. Several hundred local politicians, environmentalists and experts, predominantly from Germany, are inspecting the first pilot plant near Lago Maggiore every month. What the potential customers see is the intelligent combination of two methods that have been known for a long time: trash carbonization (pyrolysis) and high-temperature gasification.

In the first step, the trash is compressed to one-tenth its volume in a 1000-metric-ton press. Air and water escape during this process. The waste briquettes are then moved into a 15-meter-long degasification channel. Under anaerobic conditions, these briquettes are carbonized at temperatures up to 600 degrees Celsius. After two and one-half hours, the organic components have been converted to carbon. This process also creates pyrolysis gas, a mixture of methane, carbon monoxide, carbon dioxide, water vapor, acids and sulfur compounds.

Thermoselect solves one substantial problem of pyrolysis in a simple manner. The highly compressed waste packets acts as a stopper at the entrance to the degasification channel. They prevent oxygen from the air from flowing into the system thereby interrupting carbonization of the trash. Almost no nitrous oxides are created because of the exclusion of air. Removing nitrogen from the flue gases later is not necessary.

In the second portion of the process, the carbon mixed with mineral and metallic components from the trash moves into the high-temperature reactor. An oxygen flame generates temperatures up to 2500° C. At such temperatures, the carbon is gasified, metals and minerals melt, and carbon dioxides decompose. In a second oven, metals and minerals separate from one another at 1800°. Both melts cool in a water bath. What remains is a mixture that combines all metals from the trash into a black, glassy, granulate.

The synthetic gas is also shock-cooled to 90° C and purified by means of several scrubbing stages. The shock-cooling is

to prevent dioxins and furans from forming from the organic components of chlorine and oxygen. The purified gas—essentially carbon monoxide and hydrogen—generates power in the downstream gas engines and heats the pyrolysis channel.

Experts Impressed

The director of research, Rudi Stahlberg, can impress experts again and again with the preliminary material balance sheet from Thermoselect. The pilot plant reduces one metric ton of domestic trash to about 260 kilograms of mineral slag for use in road building, 30 kilograms of reusable metal mixture, 20 kilograms of salts and gypsum, two kilograms of heavy-metal concentrate and 500 cubic meters of high-energy synthetic gas. As the entire process is not interrupted and energy is not lost by cooling and reheating between the individual steps of the process, "259 kilowatt-hours of electric power remain from each metric ton of trash," according to Stahlberg.

Numerous experts have checked the statements of the operators in the past months. These include the Deutsche Projekt Union (DPU) in Essen. This organization prepared an expert appraisal at the behest of the Ministries of the Environment from Baden-Wurttemberg and Rhineland-Palatinate. The managing director of DPU, Reinhard Schultz, met a whole series of open questions and technical shortcomings. Corrosion and the lifetime of the materials that are to operate at a continuous temperature exceeding 2000 degrees has not been clarified. A complete material balance sheet has not been prepared by the operators at this time. Even the plant working with explosive synthetic gas and oxygen is, according to the DPU, inadequately equipped in terms of safety so that the plant could not be approved in Germany.

Because trash incineration in the conventional manner has a particularly poor image because of its waste gases, Thermoselect has a strength without doubt in this area. In comparison to an advanced trash incineration plant using the fluidized solids technique, the pilot plant emits only one-fifth the amount of waste gas, smaller quantities of acids, dust and sulfur compounds according to the results of the DPU. However, the emissions of cadmium and other heavy metals through the smokestack are 10 times as high. Dioxins and furans have also been found in the waste gas, contrary to the claims of the operators. However, these are in concentrations that are 10 to 100 times below the limit of 0.1 nanogram (billionths of a gram) per cubic meter of waste gas currently valid in Germany.

The second substantial positive aspect is that the granulated residues can be reused without additional treatment whereas dust and slag from the trash incineration plant must first be treated at high temperatures before they can be used in construction or placed in a dump. "Thermoselect has the very clear goal of converting trash into inert materials that can be placed in a dump," emphasizes Bernd Johnke from the Federal Environmental Agency (UBA) in Berlin. Whether the granulate, however, can be sold to the construction industry remains to be seen. "The market for crushed stone is undergoing a bitter struggle," says the environmental department head Monninghoff. However, the glassy trash can be placed in a dump with a relatively low risk since it is virtually free from organic components. In this respect, Thermoselect is arriving just in the nick of time. The Technical Guideline on Community Waste, passed at the end of April, only allows the dumping of thermally pretreated trash having organic components not to exceed 5 percent.

On the other hand, Thermoselect will certainly not quickly reduce German mountains of trash. The expert Schultz thoroughly dispelled exaggerated expectations. "From today's view, the process is not operationally safe under any circumstances and will need several years of development work to allow operation on a large scale." The Freiburg Institute for Environmental Chemistry came to a similar conclusion. "Neither the work of the devil nor a miracle machine," is the assessment of a study produced under contract to the Association for the Environment and Protection of Nature of Germany (BUND). However, the process is easier on the environment that trash incineration by means of a conventional rotary tubular kiln or grate firing.

The experts do agree that the one year of operation for the relatively small pilot plant is not adequate by a long shot to make statements regarding suitability as a large-scale plant. The operators also know this. They have contracted with the Rheno-Westphalian Technical Control Board (TUV) in Essen to determine what improvements in safety engineering, waste-gas purification and waste-water treatment would be necessary to allow the process to be approved under German law. The Rheno-Westphalian Technical Control Board will present its results by autumn. Unimpressed by the still open questions, Baden-Wurttemberg, already drowning in waste disposal troubles, has grasped for the straw of Fondotoce. A subsidiary of Badenwerk AG has pledged to Thermoselect to offer only this process for sale.

In terms of waste policy, however, Thermoselect threatens to become a step backward. About 2000 metric tons of unsorted raw trash have been processed to date in Fondotoce. In Germany, however, only residual trash from which the high-energy components such as paper, glass, plastics and biological material have been eliminated to a large extent will be used. In Italy, the advertisement that Thermoselect is omnivorous did not die away unheard. In the nearby Verbania, paper and glass are no longer collected separately since that time.

German Officials Comment on Rapeseed Oil Fuel Project

93WS0510A Frankfurt/Main FRANKFURTER ALLGEMEINE in German 2 Jun 93 p 17

["Biodiesel Fuel Only Marketable Through Tax Exemptions"]

[Text] Advocates of biodiesel fuel made from rapeseed see an opportunity for the agricultural sector, namely, growing agricultural products in order to generate power. Rapeseed oil diesel fuel need no longer be concocted solely by the

indirect method of producing rape methyl ester from rapeseed. It is now possible to combine rapeseed oil directly in a mixture with mineral oil in existing refineries. The mixture can be sold via conventional diesel fuel pumps without additional expenditures being incurred at the filling station.

This development has been achieved through a research program involving agriculture, oil mills, refineries, and the automobile industry as part of a joint project sponsored by the Ministry of Research. Professor Dietrich Schliephake of Bad Honnef, the project coordinator, in an interview with this newspaper announced that it was now technically possible to add the rapeseed oil to the diesel fuel directly. Tests conducted in the Veba Technical Institute confirm the breakthrough. However, the research program, which will run until spring 1994, has not yet determined the costs involved in producing the mixture in a refinery under different operating and processing conditions. Another decisive factor, according to Schliephake, is the operational durability of the mixture.

Some believe that, regardless of whether the rapeseed oil is mixed directly or in the form of rape methyl ester, the market must be opened to fuel made from rapeseed. Albert Probst, for example, currently a CSU [Christian Social Union] member of the Bundestag, who even when he served as parliamentary state secretary in the Ministry of Research had advocated the expanded utilization of agricultural products beyond the food industry, wants the market to be opened. To promote this so-called renewable raw material, the CSU has even established a commission with Probst as chairman. Probst considers the generation of power from agricultural products to be a matter of urgency both for the environment as well as for agricultural policy. The ecological market economy program ought not just be limited to speeches and resolutions. It must be promoted with rules, prohibitions, and incentives so as to take full advantage of the energy reservoir and ecological advantages found in agricultural products. Renewable raw materials have to be systematically utilized in all their possible applications. Helmut Born, the general secretary of the German Farmers Association, has advocated precisely that to this newspaper. Of course, no one can reasonably expect that this alone can eliminate all problems in agriculture in a short time. But renewable raw materials are already a market reality. The agricultural sector offers a broad selection of raw materials for industrial use and as sources of power. Probst maintains that there are already biodegradable substitute products available in various applicable forms for hydraulic fluids and lubricants made from mineral oil. Plastic waste can already be eliminated to some extent by means of degradable materials made from plant oils, cellulose, starches, and sugar. Reckoning to the year 2005, surplus straw could replace between 7.5 and 10.5 million tons of hard coal units; energy plants could replace 7.5 million tons, and waste wood 6 million tons.

Born estimates that 1.15 million tons of rapeseed oil would be needed to replace 5 percent of the diesel fuels consumed in Germany. At the present time 1.1 million tons of rapeseed oil is available from domestic production alone. Of this amount, 400,000 tons are used for margarine, dressings, mayonnaise, and preservation oils; another 60,000 tons are used for engine fuels and hydraulic oils. 650,000 tons are exported. Savings will be achieved with renewable raw materials as their applications increase, Born insists. However, the long-term use of renewable raw materials cannot be instituted without government support.

Cost effectiveness is not yet apparent for biodiesel fuels. Minister of Agriculture notes that for a rapeseed subsidy of 65 pfennigs, payments to take land out of cultivation (which are also paid for growing renewable raw materials) and for oil seed would also have to be provided in order to be able to catch up with diesel fuels. For bioethanol, Borchert cites a "support need" (as he euphemistically calls a subsidy) of 70-pfennig. But both Borchert and Probst insist that the problem cannot be viewed in purely economic terms. The great advantage of biofuels, as compared with mineral oils, resides in the their reproducibility and environmental friendliness.

Representatives of agriculture reject arguments of the Federal Environmental Office that contest any significant ecological advantages to be gained through the use of biodiesel fuels. Probst, together with the speaker of the CSU party Egon Susset, have called for a new scientific evaluation of rapeseed oil as a viable fuel. In their opinion, the Federal Environmental Office has distorted the true "ecological balance of rapeseed oil" through faulty research and tactics. The Federal Office is said to have needlessly made rapeseed oil an emotional question. The advocates of biofuel, on the other hand, want to focus on the scientific aspects of the question.

In order to improve the competitiveness of rapeseed oil, the EC Commission has proposed that biofuels be exempted from 90 percent of the current mineral oil tax. The German minister of finance, together with his colleagues in the other countries, wants to prevent any loss of income until biofuels are marketable.

Germany: Uses for Earth Remote Sensing Satellite Data Described

MI0406122293 Munich SUEDDEUTSCHE ZEITUNG in German 22 Apr 93 p 35

[Article by Oliver Wanke: "In Pursuit of Sinners Against the Environment: Radar Satellite Data Used in Norway"]

[Text] A central aspect of the two-year-old mission of the ERS-1 satellite, whose radar beams can penetrate even dense clouds, is the collection of environmental data for climate researchers and geographers. The European Space Agency (ESA) recently presented examples of the initial applications of the data at a symposium in Munich.

The high-energy microwaves provide an image of the earth's surface with profile accuracy to two centimeters, said Michael McKay, head of the ERS-1 mission at the Darmstadt ESOC [European Space Operation Center], where all ESA satellites are controlled. This makes it possible to monitor wave formation in the oceans and

melting of the polar ice-cap. In addition to the radar system, ERS-1 also has an onboard infrared sensor that enables scientists to carry out measurements such as heat distribution on the surface of the sea.

Damage to the countryside and the impact of agriculture are being analyzed by Wolfram Mauser, head of Munich University's Institute of Geography and Geographical Remote Sensing, using ERS-1 data. The water content of the earth's surface affects the reflective behavior of the halftones of radar images, enabling Mauser to calculate ground humidity. By comparing measurements with those taken by humidity sensors on the ground, he has developed a mathematical process that automatically calculates ground humidity from satellite images. This information enables him to determine whether, for example, maize or cereals are being grown in a field, whether it is being correctly irrigated, and whether heavy rainfall might cause flooding.

A different method is being used by Philipp Hartl, of Stuttgart University's Faculty of Navigation, who is engaged in research into volcanic eruption forecasting. It has emerged in the past that the ground surrounding volcanoes may have risen by a few meters shortly before an eruption. By using metal reflectors, which reflect radar beams from satellites particularly well, Hartl has managed to improve the accuracy with which the distance between satellites and the earth's surface can be measured to about one centimeter. If this accuracy could be achieved without reflectors, said Hartl, then volcanic eruptions could be forecast, whereas to date they can just be observed.

Another application is greatly under-used in Germany and other EC member states, in the view of many of those attending the symposium: the prosecution of offenders against the environment. Though coastal waters are regularly patrolled by the air force, the authorities rarely make use of data from the environmental satellite, the main reason cited being the lack of sufficiently powerful computers. Critics of the 2 billion German mark [DM] program claim the information is not available rapidly enough for effective prevention of crimes against the environment. Processing data for a complete picture takes around three hours, whereas a receiving station in Norway, using only part of the information, takes only around 20 minutes to produce pictures that are used by the Norwegian environment authority to prosecute ships' captains unlawfully dumping oil.

ESA originally planned to replace ERS-1 at the end of 1994 with a more advanced successor, ERS-2. However, ESA is currently discussing operating ERS-2 jointly with its predecessor, which has the technical capacity to continue operating into the next century. Scientists believe this would result in more accurate data and a shorter interval between pictures of the same location, as the satellites would rotate in sequence on the same orbit. These benefits would, however, be offset by higher costs, and it is no secret that funds for space research are scarce at present.

Germany: Environment-Friendly TV, VDU Disposal Plant Opens in Berlin

MI0206085993 Bonn DIE WELT in German 23 Apr 93 p 7

[Article by Jan-Uwe Stahr: "Assembly in Reverse for Environment Protection—New Environment-Friendly TV and VDU Recycling Method—Pilot Plant at Koepenick, Berlin"]

[Text] The picture fades forever on 4 to 5 million TV screens and computer monitors a year in Germany. These appliances, which contain pollutants, are increasingly ending their days at recycling firms.

Two engineers from the Vicor company of Koepenick, Berlin, demonstrate how the various glass fractions of scrap picture tubes can be kept separate and processed. They have designed a plant in which the screens pass not into a shredding mill, but into the experienced hands of television assembly workers.

All 30 Vicor employees once worked for the former GDR's largest television manufacturer, the state-owned Television Electronics combine. Now, at Vicor's pilot plant, they are stripping down what they previously assembled. "We call it production in reverse," says Vicor chief Reinhard Schmidtmann.

The dismantling plant comprises a carousel with four stations. At the first, the picture tubes are removed and automatically rotated into the correct position for a scoring device, which prescores the screen at the spot where it will be detached with a resistance wire at the next station, i.e., between the cone (the rear section of the picture tube) and screen glass. The dismantler at station two removes the cone glass in an upward movement like an umbrella, and conveys the part containing lead to a collection container. The next workstation removes the metallic "flat masks," through which the electron beams once had to force their way before they could make the phosphors on the screen light up. Finally, at station four, rotating brushes are inserted into the now open screen, loosening the phosphor coating from the glass surface and drawing off the two to three grams into a collection vessel.

After only four minutes, the individual parts of the tubes have been cleanly separated by type into collecting containers. The lead from the cone glass is salvaged by a glassworks in Saxony; the barium-containing screen glass serves as an ingredient for a hard building material called Magmavit; only 0.04 percent of the former picture tubes, the two or three grams of phosphor containing zinc and cadmium, have to be disposed of as hazardous waste.

Because "production in reverse" at Koepenick is completely future-oriented, the Vicor process has been awarded a prize for innovation by the Berlin Senator for Trade.

Depending on screen size, this environment-friendly dismantling costs between 12 and 18 German marks. This includes a proportion of the several hundred German marks that Vicor pays to the glassworks per tonne of lead-oxide glass it takes. The Koepenick company will

have to take the screens from the whole of Germany to exploit fully its recycling capacity of 600 items per day. This could change if the Electronic Scrap Order were to come into effect. All television sets and computers would then have to be taken back. The use of recycled picture tube glass in new screens could also bring Vicor a lot of work. Technically, this would present no problems, even today. "If only," says Vicor chief Schmidtmann, "screen manufacturers would agree on standardized lead and barium oxide admixture dosages."

Germany: Battery Manufacturers Reject Minister's Disposal Scheme

MI0806125493 Berlin ETZ in German No 7-8, Apr 93 p 506

[Text] Battery suppliers are rejecting decisively the plan by the Environment Minister Dr. Klaus Toepfer to make it obligatory for the trade and battery producers to take back all used batteries. This was made clear by Dr. Franz-Josef Wissing, chief executive officer of the Central Association of the Electrical Engineering and Electronics Industry (ZVEI), and Carsten Kreklau, member of the general executive of the Confederation of German Industry (BDI), who presented their own disposal strategy.

The planned ordinance would hinder rather than assist industry's efforts to provide environmentally acceptable products. Credit went to the battery producers for the fact that 90 percent of all appliance batteries contained no pollutants and could thus be tolerated in household waste. Wissing emphasized that there was already a return system available for the 10 percent of batteries containing harmful substances. The industry considered that only Europe-wide regulations would ensure that environmental aims were achieved without distorting competition. Unilateral national measures such as the German environment legislation were pointless in view of the Single European Market. Yet the trade and producers in Germany would be forced to introduce an unrealistic deposit system and to take back pollutant-free batteries. In Wissing's opinion, the requirements would distort the market and lead to considerable competitive disadvantages that would add another 200 million German marks per year to the costs borne by the trade and battery producers.

Germany: Juelich Center Develops Anaerobic Effluent Purification

MI0806124793 Wuerzburg UMWELTMAGAZIN in German No 4, Apr 93 p 50

[Text] About 18 billion cubic meters of effluent are produced by the German population every year. This would fill the Starnberg lake six times over, or 6 million swimming pools. Not an ideal situation.

Effluent is normally purified in sewage treatment plants using natural the metabolic processes of certain bacteria. When large quantities of oxygen are added, they process all organic pollutants. However, this "aerobic" method using oxygen requires a lot of space, and the investment and operating costs are high, principally owing to the expense of adding oxygen. There is also a problem: Sewage sludge is left over as the by-product, and this often has to be taken to hazardous waste dumps, owing to the high heavy metal content. So an effluent problem becomes a waste problem.

Ancient Method for New Technology

This was reason enough for biotechnologists Professor Christian Wandrey and Dr. Alexander Aivasidis from the Juelich Research Center to seek new ways of effluent purification. They investigated a method practised by mother nature for millions of years: when air is excluded, extremely oxygen-sensitive microorganisms (bacteria) decompose organic material, which is converted into biogas and absorbed by the atmosphere. Swamps, lakes, and paddy-fields, for example, purify themselves in this way. This natural process has so far been used on an industrial scale only for post-treatment of the sewage sludge. If this is possible, reasoned the two scientists, would it not be more sensible to let these "air-shy" specialists loose on the effluent direct.

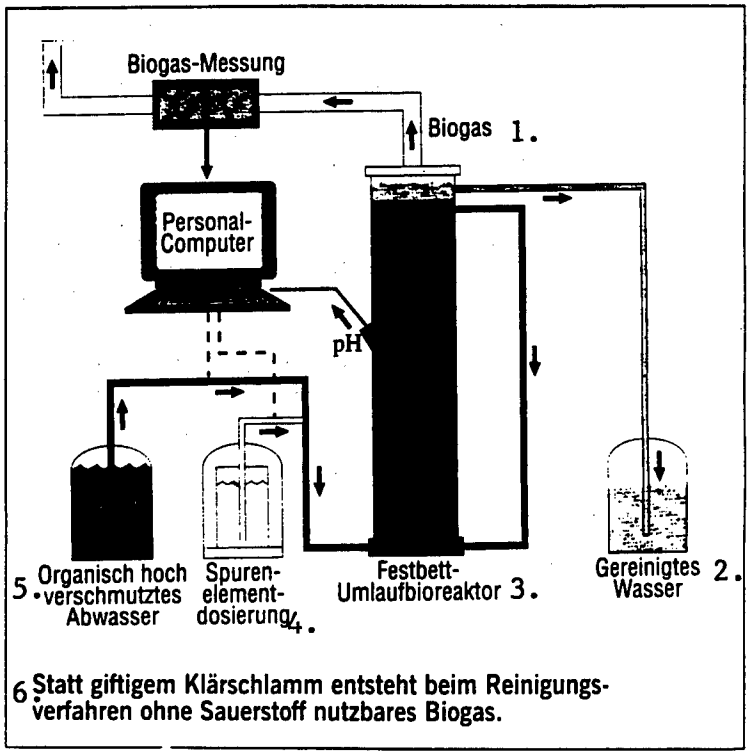
If the anaerobic method is used to purify effluent from the very start, the microbial process produces approximately 95 percent biogas and only 3 or 4 percent sewage sludge. This simultaneously eliminates the waste problem associated with conventional purification. In addition, the biogas can serve the process to provide energy. Back in 1987, Wandrey and Aivasidis were awarded the prestigious Philip Morris Research Prize "Challenge of the Future" for their "high-performance biogas method of purifying heavily polluted effluent" research project. This also signaled the go-ahead for industrial use of this environment-friendly purification method. The pioneering role was taken on by a starch factory in Luechow, Lower Saxony. Since 1987, effluent has been purified there using only the anaerobic method.

The award-winning process is now gaining further ground. Today, high-performance biogas systems are found from East Friesland to Austria. "After all," says Aivasidis, "it is the ideal purification process for sectors of industry that have to dispose of effluent with high levels of organic pollution, such as the paper industry, dairies, breweries, or food manufacturers."

Miscalculated by a Power of 10?

Nevertheless, it took time for the Wandrey-Aivasidis method to gain initial acceptance. For a long time, there was prejudice against the new purification method, which had the reputation of being "sluggish and amateurish," says Wandrey. Even the Federal Research Ministry was skeptical. A computing error was suspected in the biotechnologists' data. Wandrey says: "After we had submitted our documentation, we got it back with the remark that we had probably miscalculated by a power of 10."

Scientific recognition and an industrial breakthrough for the new process did not come until the research prize was awarded. "It is lucky," says Aivasidis, "that there are institutions like the Philip Morris Foundation that make modern technologies accessible to the public at large, thereby also stimulating interest in industrial circles. After all, our microorganisms have proved to be top-class performers. They even amazed the ministry."



Instead of Toxic Sewage Sludge, the No-Oxygen Purification Process Produces Usable Biogas

Key 1. Biogas metering; 2. Purified water; 3. Solid-bed circulating reactor; 5. Trace element dosing; 6. Effluent with high organic pollution level

Germany: Plasma-Based Waste Disposal Process Developed

MI0406135193 Wuerzburg UMWELTMAGAZIN in German No 4, Apr 93 pp 30-31

[Text] In addition to dumping, various physico-chemical processes can be used to dispose of hazardous waste. In large-scale industrial applications, however, thermal methods, such as rotary tubular kilns and fluidized bed kilns, or the low-temperature carbonization process, are primarily used. Approximately three years ago, these technologies were complemented by a new method: the ultra-high-temperature plasma process, which represents a further development in the plasma technology originally used in the steel industry.

Swiss company MGC Plasma AG is running an industrial-scale pilot plant based on this method in Muttenz (throughput: 1 tonne of hazardous waste per hour), although it is restricted for research purposes to an annual throughput of 1,000 tonnes.

Two-Part Process

The process, known as Plasmox, differs in several crucial respects from the thermal methods already mentioned. For example, the thermal process stage is divided into plasma pyrolysis and subsequent pyrolysis gas oxidation, for which plasma burners generating flame temperatures up to 20,000°C are used. Unlike conventional methods, the energy needed for combustion is supplied by electricity rather than directly from fossil fuels.

The central plant components are the feed system, the pyrolysis and oxidation chamber, and the slag discharge system. The pyrolysis chamber is fed via three systems, which may be used either individually or in combination. They are cask charging (200-liter standard steel casks), feed screw systems for precomminuted solid and pasty wastes, and a thick-matter pump feed for pumpable liquid wastes. To avoid reverse contamination, each feed system is equipped with a neutralizingflushing device. Used flush gas is fed directly back into the pyrolysis chamber, which is the heart of the entire plant.

Energy-Rich Light Arc

The chamber is equipped with two high-performance plasma burners (see illustration), both of which run on direct current. When designing the plasma burner, the Swiss engineers decided on a direct-burner system where the burner represents one electrode, and the product to be melted (hazardous waste) is the counter-electrode. A high-energy light arc, of the type familiar from electrical

welding, for example, arises between the two electrodes. To put it simply, series switching of plasma burner, light arc, and molten mass (counter-electrode) is obtained, the conductivity in the light arc comprising both ion and electron conductivity, which ensures the effective destruction of hazardous waste.

The plasma gas is fed into the combustion chamber via a hollow electrode. The combustion chamber itself, which has a capacity of two to five tonnes depending on the consistency of the molten material, is designed as a centrifuge that rotates around its vertical axis, ensuring uniform waste distribution. Slowing the centrifuge speed makes it possible to remove slag from the combustion chamber. The material is taken from the base of the centrifuge to the oxidation chamber in containers. The gases arising during plasma pyrolysis also enter the oxidation chamber through the central opening at the base of the centrifuge. The second, smaller, plasma burner ignites into this area, which means that all gaseous components are exposed in any case to the high temperature and energy density of the light arc before entering the oxidation chamber. Oxygen jets are arranged radially at the point of transfer from the pyrolysis chamber to the oxidation chamber. Oxidation takes place with technically pure oxygen or an oxygen/air mixture. After swirling for a sufficient length of time, the oxidized waste gases flow out into a special waste-gas pipe to the waste-heat boiler.

In the waste-heat boiler, a sufficient, controlled amount of thermal energy is drawn off from the hot gases and used in combined heat and power generation to give a waste-gas temperature of 450°C at the entrance to the quench cooler. In the quencher itself, the temperature gradient is reduced by thermal shock with water from 450°C to dew-point temperature, effectively preventing the reverse formation of dioxins and furans. The waste gases are carried via an aerosol separator into a multistage wet ionization scrubber, and finally to a catalytic nitrogen remover. According to the manufacturers, after purification according to this process, the waste gas meets the stringent limits set by Swiss environmental legislation (see table). It is released into the atmosphere via a chimney.

Example of Waste-Gas Measurement at a Plasmox Plant Chimney Outlet

Dust	3.6 mg/m^3
HCl	0.61 mg/m^3
CO_2	17.8 g/m^3
SO_2	5.6 mg/m^3
CO	32 mg/m^3
NO_x	21 mg/m^3
HC	1.2 mg/m^3
Temperature (oxidation chamber)	1,230°C
Volume flow dV/dt	2,060 m^3/h

The quenching water and the washing water used in the exhaust gas purification stages are piped into an effluent processing plant. A standby suction draft fan ensures that subatmospheric pressure obtains in the entire system, so there is no risk of the external area being contaminated, even in the event of a fault. The plant operators have shown in a comprehensive series of tests that the quality of the molten material, and therefore of the solidified slag, can be widely modified by adding suitable aggregates.

Post-Treatment Unnecessary

At the end of the plasma process, an amorphous slag that looks like obsidian is obtained (obsidian is a natural glass of volcanic origin). Depending on the molten mass, the density of the material is about 2.5 to 3.5 g/cm^3, and the softening point between 1,000 and 1,300°C. With a Mohs hardness of 6.5, the slag fluctuates between the hardness of feldspar and rock crystal. It is not readily soluble in water and does not react with dilute acids and lyes. Post-treatment of the slag is therefore unnecessary.

A long-term test at the pilot plant in Muttenz also demonstrated that the temperatures in the oxidation chamber (1,270°C) and at the transition point between the pyrolysis and oxidation chambers (1,320°C) can be stabilized. According to the Swiss company, the operation of Plasmox plants demands reliable off-line analysis at the input control level. This is very important for regulating the quality of the molten mass and, consequently, of the slag.

Germany: Asbestos Disposal, Recycling Process Developed

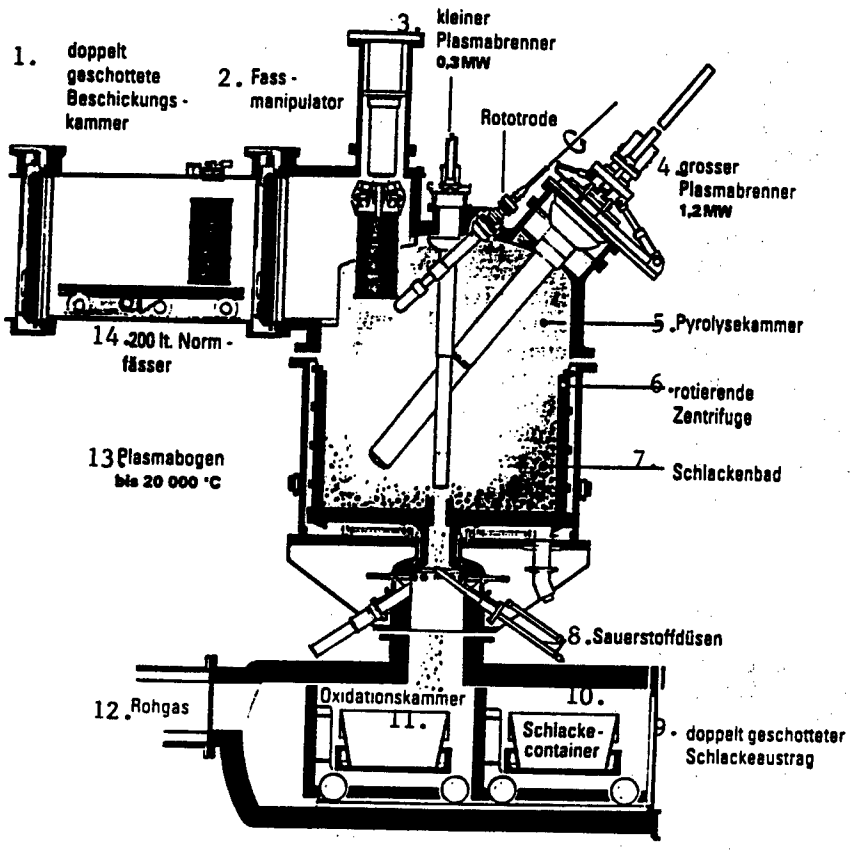
MI0306084393 Bonn DIE WELT in German 30 Apr 93 p 8

[Article by Wolfgang Asche: "Acid Can Recycle Asbestos—Burden on Dumps Could Safely Be Eased"]

[Text] Asbestos for reinforcement and insulation purposes has for decades been as good as its name, which actually means "indestructible." Asbestos matting was used for insulation, and, owing mainly to its fire-inhibiting properties, it was frequently used in fire-resistant protective clothing. The use of asbestos is forbidden. Years after the fibers have been inhaled, the substance can cause lung damage (asbestosis) and lung cancer. It is not the chemical properties that are crucial here, but the structure and size of the fiber-shaped particles (which have a diameter of less than two microns.)

If asbestos pollution limits are exceeded, buildings must be completely stripped. The fibers in dumped rubble containing asbestos must then be permanently bound. In Britain, however, asbestos dumps are being cleaned up for the first time, as no one knows precisely the scale of the hazard that they represent. In Hannover, a process has now been developed that destroys the dangerous structure of asbestos, eliminating it without trace, and preparing it for recycling as a safe building material. Solvay Environmental Chemicals has succeeded in dissolving asbestos with hydrofluoric acid. "The hazardous carcinogen asbestos becomes a high-grade recycled product," says project leader Dr. Werner Legat.

In the process, silicon reacts in the mineral fiber with fluorine to form hexafluorosilicate. This destroys the asbestos structure, which cannot reform. Milk of lime (calcium hydroxide) is added to neutralize excess hydrofluoric acid. The solid end product can be used as an aggregate in the manufacture of cement building blocks, the dangerous asbestos structure having been eliminated.



Kernstück der Plasmox-Technologie ist der Plasma-zentrifugalreaktor – hier in der Schemazeichnung.

The core of Plasmox technology is the centrifugal plasma reactor—here shown schematically.

Key: 1. Double-walled feed chamber; 2. Cask manipulator; 3. Small 0.3-MW plasma burner; 4. Large 1.2-MW plasma burner 5. Pyrolysis chamber; 6. Rotating centrifuge; 7. Slag bath; 8. Oxygen jets; 9. Double-walled slag discharge chamber; 10. Slag container; 11. Oxidation chamber; 12. Crude gas; 13. Plasma arc up to 20,000°C; 14. Standard 200-liter casks

Dr. Legat sees initial potential for the "Solvas process" in cases where substances are contaminated by small amounts of asbestos. Such cases could include blocks from old night-storage heaters (which were clad in asbestos matting), or items of clothing. Plastic clothing treated in the "Solvamat washing machine" and freed from asbestos can even be reutilized. The Kaefer company from Bremen is already operating a pilot Solvas plant.

FACTORY AUTOMATION, ROBOTICS

German Research in Neural Networks to Guide Robots

93WS0468C Zurich NEUE ZUERCHER ZEITUNG (INTERNATIONAL EDITION) in German 12 May 93 p 49

[Article by Holk Cruse and Helge Ritter: "Robot Guidance by Means of Neural Networks"]

[Text] To date it has not been possible to reproduce technically many relatively simple human capabilities as, for example, language comprehension, scene recognition, or—in the case of robots—the execution of adroit walking or grabbing movements. With regard to the last mentioned problem, i.e., robot execution of routine movements, the Bielefeld University has recently made considerable progress. The advances are attributed to the use of neural networks and to the reproduction of the natural mechanisms animals employ in their movements.

Network Pattern Capable of Learning

While it is true that computers are far superior to humans in making calculations, it is also true that they are infinitely inferior in everyday functions such as seeing or running. Even the common frog or an insect excels over the computer in those functions. This fact is rooted in the many important differences between conventional hard- and software and information processing in biological

brains. One important difference is the parallelism of processing. Numerous neurons are active at the same time. The "intelligence," i.e., the program, resides in the connective pattern that combines the individual neurons into a network (Fig. 1). Another special characteristic of biological brains consists in the fact that the links between neurons are not rigid, but rather change under the influence of the transmitted impulses. This special property is the key to explain the remarkable ability of life forms to adapt their behavior and to learn.

Artificial neural networks are systems that imitate both of these important properties of biological brains. They consist of a network of many simultaneously active, interconnected calculating elements. The connections are changeable by means of feedback mechanisms, i.e., neural networks are capable of learning. Neural networks differ radically from conventional computer architecture in both these properties.

Nature's Example

In simulating biological capabilities by means of neural networks, one can literally begin from point zero, i.e., as if the organism to be simulated were without any preexisting knowledge—a kind of *tabula rasa.* That would be ineffective however, and would not in general correspond to the natural order. Every newborn creature comes fitted with a number of mechanisms that permit it to learn to perceive and act easier. It is therefore advisable, when creating "artificial" intelligence, to fit the computer out with certain initial capabilities to prestructure the subsequent learning process.

Two teams of researchers—one in Bielefeld University's Technical Department and the other in its Biology Department—combine both these approaches for the problem of robot guidance. The learning capability of neural networks is employed to simulate sensorimotor capabilities, and the networks are prestructured according to biological principles that have been discovered in animals.

The common goal is to develop neural algorithms to guide robot motions. The "pattern recognition" research team in the Technical Department is teaching the robot hand how to grip. In future, gripping motions will no longer have to be so painfully programmed. Rather, they will be guided via camera by the hand motions of a human operator. In this way, the robot will be "taught" to perform the desired work procedure by "demonstration," as it were. In addition, the learning capability of the artificial neural network is brought to bear.

Before the common goal can be reached, many component problems have to be solved. The inherent difficulties are for the most part unknown. Gripping motions, for example, are everyday routine operations that we perform almost automatically without really knowing how. Consequently, the position of the hand of the human operator has to be recognized and distinguished from other objects in the working field. Then the recognized hand position has to be converted into the appropriate joint angle position for the robot arm and the finger joints of the robot hand. In the process, the different geometry of the robot hand vis a vis the human hand has to be taken into account. And the complex frictional and sliding conditions of the finger surfaces when gripping an object cannot be ignored either. Often they do not emerge from image data, and it is precisely our unconscious mastery of them that comprises most of our motion skills. Consequently, even an artificial gripping hand needs a certain amount of "native intelligence," in order to react independently and as the situation demands to such conditions.

At first glance, one might think that the answer to these problems could be found in theoretical mechanics. Unfortunately, it turns out that the mathematical analysis of the interplay of several fingers with an object is enormously complicated and impracticable. And what is most difficult is the fact that we simply do not know the precise required parameters as, for example, the friction constants of the surfaces or even the exact form of the object, to be able to analyze many actual gripping operations, say, tying a string.

For that reason, the "pattern recognition" team is pursuing a different research path. It is developing a learning process by means of which the knowledge required for gripping operations can be learned by the robot during an exploration phase. On the other hand, it would be wasteful to begin at point zero and not use previously acquired knowledge on such movements. Even in the natural state, an animal—from the beginning of its life—possesses a rich repertoire of reflexes which substantially prestructure its movements. Our basic idea, therefore, is to introduce in the artificial robot hand system as much knowledge of basic movement patterns that analyses indicate is feasible, and to assign to the learning process the task of combining such basic patterns correctly.

In the last few years we have developed an approach to accomplish just that. All possible robot hand movements are translated into a "labyrinth" within an abstract "configuration space" (Fig. 2). Each path in the labyrinth corresponds to a gripping movement, while the structure of the labyrinth represents the knowledge that limits the possible gripping motions to reasonable choices. Preknowledge can only be introduced in the form of a partial prestructuring of the labyrinth. The robot must therefore ascertain the unspecified parts of the labyrinths by exploratory movements during a learning phase. During each gripping experiment it also receives feedback reports from a variety of sensors that signal the success or failure of a movement sequence. So far these approaches have been tested in comprehensive simulation calculations (Fig. 3). The fabrication of a three-fingered hand, whose hardware is being built by another team at the Munich Technical University, is expected to appear first.

Recognition of Hand Positions

Despite the progress made, it would be unrealistic to let the robot plan all aspects of a gripping motion autonomously. This is particularly true in the guidance of multifingered hands. Usually, a kind of "sensor glove," which mechanically takes the hand position of a human operator and forwards the joint angle to the robot, is used. Because of

the elaborate mechanics involved, this kind of guidance is extremely difficult to service. Consequently, the aim now is to utilize only the optical image of a human hand for contact-free guidance.

To be sure, the recognition of a three-dimensional image of a human hand in itself represents a complicated image-recognition problem. As in the case of gripping, here too the knowledge concerning the relationship between visual shape and three-dimensional form has to be introduced in the image recognition system in the proper form. In most known processes, this is accomplished by means of geometric models of the objects to be recognized. Such models are well suited for technical objects characterized by straight-line, even forms. However, this process is very costly for curved-line objects whose shape changes, as is the case for human hands.

We have therefore—in the past few years—developed a neural network with a learning capability that can learn the necessary visual knowledge from training examples. Unlike conventional image-processing systems, it manages to dispense with the need for an object model given by the user beforehand. Instead, the only thing required is that a large number of hand positions be "preplayed" for the network during a training phase. This is presently being accomplished by means of a dummy wooden hand controlled by an auxiliary robot. After the training phase, the network is able to recognize the hand positions that appeared before the camera, and—to a certain extent—can even generalize them to new hand forms. The hand-position information thus extracted so directly from the image can then be used to guide the robot hand. In this project we are currently working very closely with neurophysiologists who are researching the architecture of the visual system of toads. The robot hand is attached to an arm, the guidance of which presents its own problems. The investigations of the "biological cybernetics" team in the Biology Department are focussed on this problem.

Guidance of a Robot Arm

At first the biologists simply observed how man moved his arm in specific situations. A problem of particular interest is to determine how an arm moves when it attempts to solve a particular problem with fewer joints than it actually possesses. This is the case when the arm executes a purposeful movement in the plane, since the arm has more than the two joints needed for the task. Owing to the surplus degree of freedom, no definite solution is possible. There are many arm positions with which one can point to a given aiming point. In this situation it is more complicated to calculate the arm position because rules have to be introduced to eliminate the redundance. For that reason, designers of robot arms try as far as possible to avoid the problem of guiding a redundant manipulator. On the other hand, neural networks are able to solve the redundancy problem. Such a network assigns the particular joint angle to the arm for each aiming point that is most comfortable for the position of the entire arm.

However man cannot just take those arm positions that are comfortable. If, for example, one has to get around an obstacle in a purposeful movement, additional limiting conditions come into play. How is the arm controlled in such a case? Introspection leads to the assumption that we have a "mental model" in mind—a conscious or unconscious spatial concept of specific arm positions. It is conceivable that this kind of inner model, which represents the geometric properties of the arm, can be used to suggest an arm position that would be possible in precisely that situation. After this internal representation has been completely developed, the joint angle can be ascertained and used to guide the actual arm. A neural network that simulates this "mental model" has been developed using a structure with multiple feedbacks. It has already been successfully used to guide the joints of a robot arm.

"Walkers." These concepts for guiding arms are also useful when one wants to understand how an animal solves the problem of walking over an uneven ground surface with his legs. Quite similar rules obtain for guiding legs as do for arms. To be sure, the movements of legs are not independent of each other as are arm movements, since they are mechanically linked when walking on the ground. Were the requisite coordination of the legs missing, the animal, even if he had six legs like an insect, would quickly fall over.

Extensive studies have been made on crawfish and stick insects in this regard. What is interesting is that there is no central control mechanism. The regular coordination pattern of the legs derives more from the interplay of the six individual systems. This dispersed "decentralized" structure, in which the control center of each leg constitutes a particular, almost autonomous unity, corresponds entirely to the principles that underlie the concepts concerning neural networks. It is therefore reasonable to simulate this system as an artificial neural network. Figure 4 [not reproduced] shows a section of one such simulation. The six-legged walking device controlled by artificial neural networks "walks" very stably in the simulation; it overcomes obstacles easily without losing its step. The quality of this guidance system is now being examined to determine how it guides a real six-legged walking device (a "walker"). So far one real leg exists, while the other five legs are still simulated. The first tests were successful.

Unlike other walking machines that have already been built in the United States and Japan (and later mostly abandoned because of the complexity of the problem), a decentralized guidance system, in complete harmony with biological findings, has been developed that is 1) much simpler to build, 2) sturdier than its predecessors abroad, and 3) better able to adapt to unforeseen changes in it environment.

In recent times, the concept that our entire brain is structured and comprised of many, partially autonomous units has gained more adherents. Marvin Minski, one of the "fathers" of artificial intelligence, has described these units as agents. According to this theory, our behavior is the result of the interplay of brain agents. The sensorimotor systems investigated here could therefore also serve as a model for the interplay of agents in systems that control even more complex behavior.

Photo Captions

1. p. 49 (column 1): Section from a natural neural network. The connective system of the neurons in the cerebral cortex of a cat is shown. Many networked structures with feedback systems exist in the brains of living creatures. They can process data parallelly and are capable of learning.

2. p. 49 (column 2): A labyrinth showing the possible movements of a robot hand. Each path in the labyrinth corresponds to a gripping movement. The structure of the labyrinth represents the knowledge that limits the possible gripping motions to reasonable alternatives. The robot must investigate as yet unspecified parts of the labyrinth by exploratory movements during a learning phase. By means of sensors it obtains feedback on the success or failure of its movements.

3. p. 49 (column 4, top): Simulation model of a hand. Before one works with actual robot hands made of wood or metal, the guidance techniques are tested in extensive simulation computations. Simulation models are used for this purpose.

4. p. 49 (column 4, bottom): A six-legged walking device climbs over an obstacle. The images are obtained by superimposing individual images of a video sequence. Above is a top view; below is a side view of the model. The walking device is controlled by artificial neural networks. It walks stably and overcomes obstacles without losing step.

[The author Holk Cruse is professor of biological cybernetics and author Helge Ritter is professor of pattern recognition and neural networks at Bielefeld University. The original version of this article was published in Forschung an der Universitaet Bielefeld, No. 7, 1993, pp. 26-32]

Germany: Maho Opens Flexible Factory for Machine Tools

93WS0506A Paris TECHNIQUES & EQUIPEMENTS DE PRODUCTION in French Apr 93 pp 20-22

[Article by special correspondent in Germany Michel Defaux: "Maho's Model Factory"; first paragraph is TECHNIQUES & EQUIPEMENTS DE PRODUCTION introduction]

[Text] In the midst of a slump in the machine-tools industry, the German manufacturer is launching the flexible superplant it decided to build in 1988. The factory is a high-performance tool, and its profitability will hinge on production agreements with other companies.

The sight from the visitors' corridor on the first floor of the Maho factory is impressive! Guests are greeted with a bird's eye view of a flexible plant such as is rarely encountered in the manufacturing world, and which is certainly unique in Europe's machine-tools industry.

The only installation anything like it—the Yamazaki flexible shop, which was inaugurated in Birmingham in June, 1987—required an outlay of 350 million French francs [Fr] and boasted 22 machines, including three big machining centers. Maho invested Fr540 million in its Kempten factory (60 km from Munich), which will ultimately house 25 big machine tools.

In a situation that is, to put it mildly, paradoxical, Maho is launching its flexible machining factory at the nadir of the machine-tools market. The factory was originally designed to produce 3,000 machines a year. That number has now been scaled back to 2,000 (13 of the 25 machines originally planned have been installed), while Maho is selling around 1,300/1,400 machines annually. "When we planned the factory in 1988, business was booming," points out Peter Schneider, the new plant's manager. "We couldn't keep up with the demand, which required us to produce smaller and smaller runs of different and increasingly complex machines."

A Production Cycle Reduced by a Factor of Eight

Hence the basic design of the plant, which was built for the rational production of small machine-tool runs as tiny as one unit. The whole factory was designed to machine foundry pieces, essentially of cast iron, to be incorporated into milling and boring machines. Examples include tables, frames, machining-center rams—all the big milling pieces (the machining pallets measure 1,250 x 800 mm). Two rail-guided cars run the length of the 160 m x 42 m air-conditioned building (20° C +/- 1°), splitting it in two. On one side are the warehouse for blanks on wooden pallets, the area for preparation and clamping of the pieces, and the grinding line. On the other are the machining centers and fineboring machines.

The flexible factory employs seven to eight people: two in grinding, three to four in milling, and two to three in preparation and clamping. The area for preparing the pieces and clamping them onto milling pallets is the starting point. Operators receive the information sent from process engineering and can call up the piece's design or clamping diagram on their screens. "At first we thought clamping the pieces was simple. But actually, only very skilled journeymen can keep the pieces from being stressed and strained."

Maho's flexible factory also adheres to a basic rule: Pieces must be completely machined after a maximum of four runs through. A vertical frame, for instance, is finished after two passes, instead of the seven or eight required before, with each run through involving unclamping and removal, storage, and parts in course of manufacture (machining, hardening, remilling, grinding of slideways, etc.). "Our goal was to shorten the cycle and make it flexible. The overall improvement ratio is 1 to 8, but on certain pieces we do better. For example, a table with T grooves used to take 30 days; here we produce it in 21 hours."

The Only Factory of Its Kind in Europe

Engineers selected four Waldrich Coburg planar-type grinding machines, able to handle 1,400 x 600 x 2,000 mm, for grinding of the pieces. An automated device connected to a storage area that can hold 10 machine tools changes

the molds without human intervention. The automated devices are rather exceptional since there are only six of them in the world (the two others were delivered to Okuma in Japan). To make it easier to launch this equipment, operators spent six weeks at Waldrich Coburg grinding representative pieces.

Work Quality of 5

The ground parts, transported by rail in a shuttle, then move to the 28-liter-capacity machine for washing pieces and pallets.

The washing machine eliminates the smallest chips or particles. Indeed, given quality constraints (tolerances of +/- 2.5 microns on 1 meter), only thorough washing of the pieces can insure perfect positioning. The same type of machine is installed on the milling line.

After washing, the pieces make a stop under the Leitz 3D measurement machine. The latter is placed on a 60-ton concrete slab, cushioned by eight pressure cylinders to prevent any vibration.

The last machine on the line is the 200-kW-capacity device for induction hardening of the slideways. "It is the only device in the world that has an automated inductor-changing system," stresses Peter Schneider. "The electrodes adapt to the shape and size of the slideways, and the parameters are automatically adjusted."

The second part of the factory, on the other side of the interoperations storage area, is reserved for the milling centers and fineboring machines. Here too, Maho has installed the best-performing machines tools available. "Machining productivity has jumped 30 percent, thanks to higher cutter bar speeds—6,000 tr/min in ISO 50 for instance—and high speeds of 30 m/min. And quality has improved at the same time. The antivibration machine tools we developed jointly with Dixi now enable us to work in quality 5." The way the work is organized has not changed: A rail shuttle car feeds the three Dixi 560 TPA fineboring machines (there are only four of them in the world), four Ingersoll Bohle horizontal machining centers, and two Waldrich Coburg vertical centers with three linear axes. The last two machines are linked by a gantry crane that changes 14 specialized heads. This makes it possible to roughly mill in the "T" grooves of the machine tables and finish them, after a head change, by planing the surface. The method is said to be the only one that can guarantee the precision of the clamp grooves.

Becoming Competitive With the Japanese in Machining

The factory receives orders for pieces from its parent factory at Pfronten, determines how to route them, and checks the work programs (availability of machines, blanks, clamps, and classic and special tools). "We can get any outside clamping system made in six weeks. Three days before the start of machining, we check that all the components are available and give the green light."

Maho engineers conducted all the studies and the company's FS 2000 software program, which it has already marketed, runs the process. So while Maho was putting together a fantastic production tool for itself, it was also building a showcase. The flexible factory is a significant asset as well in the discussions underway with other German manufacturers, as Christian Androschim, the commercial director, points out. "We have a production system that enables us to be competitive with the Japanese in machining. True, we cannot run it at full capacity right now. But it is our great good fortune to have the only machine-tool factory of the kind in Europe, at a time when other firms are no longer able to make a similiar investment. Hence the discussions underway with several manufacturers."

Boxed Material

A Single Specialty: Milling

A collapsing market and hefty investments in new production facilities led Maho, the world's 17th largest machine-tool maker, to announce 157 million German marks [DM] in losses for the fiscal year ending June, 1992. German banks, which agreed to a capital increase, now hold 50 percent of the company, while the share of the founding Babel family has shrunk from 50 to 20 percent. The company plans to break even again during the 1994-95 fiscal year.

To do so, it has launched a sweeping restructuring plan built around two central themes: first, focus on milling and boring; second, reduce the number of production sites.

As a result, Maho shut down its Emstal (Germany) and Naugatuck (Connecticut, U.S.) sites last year. The company shelved plans to diversify into electroerosion when it sold the Dieter Hansen group, which it acquired in 1989, to Ingersoll. Maho also sold two other plants to Ingersoll: a recent factory in Gross Umstadt (Germany) and one in Wattwill (Switzerland).

Its final move was the closing of the Budapest (Hungary) factory last February.

Maho now has three production plants: Seebach in former East Germany, which specializes in the manufacture and assembly of small machines; Pfronten, which houses the company's headquarters, engineering and design department, and big machine assembly shop; and Kempten, which is dedicated to the flexible machining of big foundry pieces. What is more, you will not see the Maho name on the front of the Kempten plant. Indeed, the facility may act as a subcontractor (sale of its production capacities) or as a multiownership factory (sale of shares). Discussions with Deckel, which would like to close production sites in downtown Munich, are said to be well advanced and may even produce something broader than a production agreement.

Germany: Eos's Rapid Prototyping Technology, Strategy Viewed

93WS0509A Munich TOP-BUSINESS in German Jun 93 pp 118-121

[Article by Josef Stelzer: "Models in a Hurry: Eos Pioneer"]

[Text] *Hans J. Langer has made a name for himself with highly sophisticated, guided lasers. They reduce development time for prototypes to a fraction of the cost of current processes.* Hans J. Langer has big plans for the future. Langer, the business manager of Eos [Electro Optical Systems GmbH] will accept nothing less than to become "technologically-speaking 'Number One' in the world." In Europe, and that is all but conceded, the founder of Eos wants "of course, to remain the market leader."

Is that too fanciful a notion for a youthful entrepreneur who—with but 25 colleagues—has already achieved a yearly turnover of 8 million German marks [DM]? Not at all! This 41-year-old businessman has—in a very short period of time—attained a strong standing in the business world by virtue of his computer-supported lasers used for the automated production of three-dimensional prototypes. BMW AG in Munich, for example, swears by the revolutionary technology. The impressed automobile manufacturer chose Eos from among seven competitive systems.

Langer's computer-guided lasers reduce the costs of model-building to a fraction of what they have been, while dramatically shortening prototype production time. Langer offers just what is needed in today's competitive scene in that rapid prototyping methods improve marketing chances by providing ever shorter development cycles.

Langer's career began at the Munich Technical University, where his doctoral dissertation on laser development won his acceptance in the Max Plank Institute in Garching in 1980. The newly appointed scientist recognized immediately that the market would become "incredibly dynamic," owing to the introduction of laser technology in so many branches of industry.

Seeing that the scholar's life could do little for him, he made the logical jump to industry. After entering the marketing business in a Starnberger company in 1981, he became immediately successful.

Despite his lack of marketing experience, this talented man increased the turnover of mirror systems for laser-guidance dramatically. In return, the company, General Scanning Inc. of Boston, offered him the top spot in its newly established German branch. The ambitious Herr Langer jumped at the opportunity.

New Markets in Sight

In Europe, he presided over the rapid growth of a $1 million turnover to a $4 million turnover. For the independent-minded manager this achievement seemed reason enough to demand shares in the German General Scanning affiliate as a quasi reward for his work in building the business up. But the Boston owners thought differently, and the disappointed Langer soon left General Scanning.

There was another factor behind his decision to leave the Americans in late 1988. The U.S. company's strategy of concentrating on its traditional basic business with inscriber and material processing systems seemed to the laser specialist not too promising for the future.

Difficult Beginnings

Langer decided to take a completely different path. In the late 1980s, he heard of a new type system used in stereolithography—a kind of three-dimensional printing by means of computer aided design, UV-lasers, and light-sensitive plastics. It was like a revelation to the young physicist: "This combination has got to have tremendous market potential!"

He made the decision "to finally do something on my own" almost impulsively. In early 1989, a few weeks after leaving General Scanning, he, with a few associates, launched the Eos system operation. However, the early days, operating out of a poorly equipped workshop, were anything but happy. Because he was unable to find a financial backer for the pilot project, he was forced to stay afloat by serving as distributor of products from various other companies.

A few months later, Langer learned quite by accident of a brand new facility for the production of prototypes that had been tested at BMW. The news came at precisely the right time. The automobile producer was not at all satisfied with the device. The plastic parts it produced did not match the geometry model as it had been established by means of CAD. This was reason enough for the frustrated BMW developer to order the promising Eos stereos in mid 1990. Pleased, the managers of the Munich firm soon ordered a second aggregate for about DM1 million.

European Technology Holding, a venture capital company in Amsterdam, provided the basic financial support for Langer to go into business. Since the much longed-for BMW contract was already in the bag, it did not take long to convince the technology-loving business manager of the venture capital company. In exchange for 24.9 percent of Eos shares, the risk-capitalists put up DM1 million. Langer was able to get another million from the German Federal Government's program for young technology entrepreneurs.

The monies were well invested. In a very short time Eos made its debut on the international stage. Even from Japan, where only Mitsubishi offered a similar product, came interested clientele to visit Planegg in Bavaria. Hitachi, for example, soon had an Eos machine in operation and another was ordered last March. Langer also did business with Mercedes-Benz AG, the Pininfarina body cutter, Fraunhofer Society laboratories, as well as with the Dresden, Graz, and Lisbon universities.

There is no lack of potential applications for Eos technology. By means of stereos, BMW, for example, produces various elements for automobile interiors as well as engine and undercarriage parts. The more filigreed and complicated the required prototypes are, the better the Eos system can show off its advantages. On the basis of the CAD design, a very complicated cylinder head, for example, can be fabricated automatically with an accuracy of about 0.1 to 0.5 millimeter.

The part is built up slow layer by layer from its lower edges with light-sensitive l. uid plastic. Hollow spaces are

very simply created by not exposing the cavity areas. In the final work stage, the finished prototype is literally lifted out of the bath. In this way, the gleaming yellowish models match the corresponding metal components to a hair.

Weak Spots Eliminated

Previously, this had not been a simple matter. The problem was that the plastic used to shrink and bend when subjected to laser hardening. Langer of Eos was the first in the world to rectify this rather considerable weakness by means of a simple trick. Instead of simply following prescribed lines with the light beams, as had been done to date, the improved processor-guided system describes tracks especially layed out by Langer. In this way, the shape of the plastic part remains stable.

All in all, it takes a maximum of two weeks to produce a model. In contrast to conventional processes, in which gypsum, wood, or rigid foam are used, Langer promises a 90 percent time saving. The costs, too, drop in the Eos method by at least 50 percent. This represents an impressive saving when one considers that in conventional prototype construction a cylinder head model, for example, could not be built for less than DM150,000 and construction time was often a year.

Contract Book Filled

Another plus for Langer is that stereos produce a multitude of design variations in a short time. Moreover, the innovator from Planegg offers a variety of plastics as, for example, a rubber-like mixture for door seals, transparent plastics, and heat-resistant materials. In addition, there are systems for models with 300, 400, and 600-mm edge lengths.

And even those users, who need more comprehensive prototypes, will not have to wait much longer. The Bavarian design team is working at high pressure on a concept for larger machines capable of handling edge lengths a meter and more in length.

Eos go-getter Langer is also getting ready for the international scene. He has founded an affiliate in Lyon with three associates and soon the first machine will be delivered to a French university. A total of 15 systems have already been sold; 10 more are in the contract book for delivery in about three months. These orders suffice to expand the production capacity of his Bavarian facility to two systems a month.

Langer is not worried about the future, despite the persistent weakness in the economy. He estimates that the European market for stereos and comparable systems to be several hundred a year. "Rapid prototyping is just coming into its own," Langer insists confidently.

Summary

Eos Electro Optical Systems GmbH, located in Planegg near Munich, was founded in 1989. Turnover in 1991/92 was DM4 million; anticipated turnover in 1992/93 is DM8 million. The company, which has 25 employees, produces systems to automate prototyping. Eos is among the world's leading producers. Hans J. Langer, the business director, controls 75.1 percent of company stock; European Technology Holding in Amsterdam holds 24.9 percent of company shares.

UK: New Ultrasonics Testing Technology Described

BR1606141593 Toddington NEW MATERIALS INTERNATIONAL in English Jun 93 p 1

[Unattributed article: "Ultrasonics Test Ceramic Engine Parts by Robot"]

[Text] Automotive and aerospace companies experimenting with new materials for parts of complex shapes are beginning to take advantage of new ultrasonics testing technology.

The development of ceramic passenger car engine components and new alloys for turbine blades are the first applications for a 400,000 German mark [DM] prototype robotic cell equipped with ultrasonic sensors shown recently by German electronics specialist BGT [Bodensee Equipment Technique].

Equipped with a gripper-change system, the BGT UKROS-316 six-axis articulated robot is, if necessary, able to first define the shape of the component to be inspected using a touch probe, and then take the ultrasonic sensor to precisely perform the surface scanning program—an operation that has to take place under water.

The first installation of the BGT robot is at the Fraunhofer Institute for Non-Destructive Testing where researchers will provide the aerospace industry with a facility for testing new types of turbine blade.

Meanwhile, BGT's own engineers are working with the automotive industry to apply the ultrasonics technology to the testing of new ceramic engine components. It is a growing field, says BGT marketing director, Claus Keferstein, because 100 percent of ceramics parts produce must be tested.

LASERS, SENSORS, OPTICS

EUREKA Project: High-Power Laser for Cutting, Welding

93WS0416A Stuttgart LASER UND OPTOELEKTRONIK in German Apr 93 pp 42-46

[Article by E. Goeller, R. Huber, R. Ifflaender, P. Schaefer, K. Wallmeroth, and D-7230 Schramberg, received 2 December 1992: "Laser Material Processing: 2kW-CW Laser, Presentation of the Results of a EUREKA Project"]

[Excerpts] [Passage omitted]

Abstract

Since Nd:YAG lasers with average powers in the kW range are commercially available, material processing by this type of laser has attracted considerable attention. Transmission of the laser radiation by optical fibers enables an uncomplicated implementation of the laser into produciton lines. For 3-D applications coupling of the radiation to a robot can be easily accomplished.

The design and electro-optical characteristics of a 2kW-CW Nd:YAG laser are described. The results of laser cutting and welding trials via an optical fiber are presented. For more details see 5. Extended Abstract.

Summary

The design and power characteristics of a 2kW-CW Nd:YAG laser are described for material processing. The beam is conveyed to the workpiece via an optical fiber. The results of laser welding and cutting trials are presented.

[Passage omitted]

1. Introduction

Solid state lasers with power outputs in the kW range have been available for some time now as laboratory models for pulse as well as continuous operation. Ranges of application for them will probably be found and investigated which up to now could not be covered by commercially available solid state lasers suitable for industrial use. At the same time the low power range of CO_2 lasers will probably be usefully extended by the diverse possibilities produced by fiber-optic transmission.

A working model of a 2kW-CW laser was built as a partial ojective of the first phase within the framework of the BMFT's [Ministry for Research and Technology] EU-226 project in order to be able to conduct application studies with it as the project progresses. Cooperation among the individual partners, such as universities, laser manufacturers, and component suppliers, up to and including applications institutes, can make possible with it additional basic studies.

To guarantee rapid availability and a high degree of operational safety, the working model was built in a largely conventional manner. The details will be described somewhat more fully below.

2. Design and Characteristics of the Laser

2.1. Power Supply

The essential purpose of the laser power supply is to supply the arc lamps of the pumping chambers with the required amounts of current. These lamp current values should, on the one hand, exhibit a narrow range of current fluctuation but, on the other, be capable of being switched very quickly.

The necessary pump output for a 2kW laser is about 50 kW distributed over several pumping chambers.

The direct current regulators form the key component of the power supply. Each arc lamp is supplied with the desired lamp current by its own direct current regulator. The direct current regulators are implemented in a "phased" technology and operate directly on the rectified three-phase network. In conjunction with the current-regulating technique used for this application, a high switching frequency enables the operator to switch the lamp current very quickly.[1] [see References]

Every two direct current regulators are assembled together with the spark-booster switching circuit and the accompanying control and regulating electronics as a CW current source. This is mounted together with the cooling unit, controls, and power supply in a control cabinet, the supply equipment unit. Each of the supply equipment units supplies a pumping chamber, in the process of which synchronous control of several supply equipment units is effected in accordance with the master-slave principle.

Each of the four supply equipment units delivers a maximum electrical pump power of 16 kW, that is, a total of 64 kW. The direct current regulators are designed for arc lamps with different current-voltage characteristic curves. the degree of efficiency of the laser current supply is greater than 93 percent and the power factor—the ratio of efficiency to apparent output power in the three-phase current network—comes to about 0.9. This permits a compact type of construction with little weight.

The high switching frequency of the direct current regulators makes it possible to switch the lamp current in less than 1 ms from the minimum to the maximum value and vice versa. This opens up new possibilities with respect to rapid on-line adjustment of laser power during material processing.

2.2. Radiation Source and Resonator

The multicavity layout is just the thing for increasing the power output of solid state lasers in the kW range simultaneously with good beam quality. With the arrangement used here, several laser rods are operated in a common resonator. Thus, a system with n rods attains the n-fold output of a one-rod system with the same beam quality.

Each laser rod is built into its own pumping chamber, which supplies it with the necessary pump power and cooling. The pump light is produced by two krypton arc lamps and projected onto the rod by a double-elliptical, gold-plated reflector. The rod as well as the lamps are surrounded by flow tubes through which deionized coolingwater flows.

The beam parameters of a laser are basically determined by the resonator. Symmetrical plane-plane resonators of different lengths were used with the system presented here. In solid state lasers conventionally assembled with laser rods, the resonator parameters depend on the operating requirements for the laser. The laser rod is warmed by the pump light throughout its entire volume and cooled over the surface of its casing by the cooling water. The drop in radial temperature thus produced results in a gradient lens because of a refractive index in the rod that depends on the temperature.

For low output power (low pump power), the lens has a long focal length and a short one for high output power. Since it is inside the resonator, it affects laser beam parameters such as divergence, beam diameter, focusability, and position of focus on the workpiece. There are no constant beam parameters while the operating parameters are being changed.

2.3. Fiber-Optic Laser Cable (LLK) and Thermal Lens Compensation

The radiation of the multicavity system was transmitted with multiple index fibers of different diameters. Multiple index fibers have the property that, for not too small an angle of incidence of the laser beam as it enters the fibers, as the light leaves the fibers, it does so at nearly the same angle. The cross-section of the exiting beam is produced by the diameter of the fiber. The position of the focus on the workpiece is solely determined by the image formed at the end of the fibers and is independent of the beam parameters of the laser.

The influence of the operating parameters on the beam can be compensated for with the aid of the fiber-optic laser cable. If the angle of incidence of the beam as it enters the fibers can be held constant, a constant exit angle and fixed beam parameters are obtained. To achieve this, a static optical system consisting of a convex lens that focuses the laser beam in the fiber-optic cable is necessary. If the focal length of this lens as well as the distances from the output coupling mirror to the lens and from the lens to the fibers are properly chosen, the desired imaging is obtained. A constant input coupling angle as well as a constant beam diameter are produced as the beam enters the fibers independently of the laser parameters. As a rule, this beam diameter does not correspond to the waist. Only at one point of the workpiece does the waist lie on the surface of the fibers; otherwise, it is before or behind it. The constant input coupling angle produces constant ratios at the fiber output. The constancy of the beam diameter at the fiber input—it is focused to a diameter slightly smaller than that of the fibers—ensures that the surface of the fibers cannot be locally overloaded.

2.4. Electro-Optical Characteristics of the Laser

With a maximum beam parameter product of 40 mm x mrad, an output power of 500 W per cavity is obtained with an input power of 14 kW. The laser power output with four pumping chambers comes to 2150 W. Illustration 2 shows the measurement curve right at the output of the beam source and after the beam has passed through a 1000-µm and a 600-µm fiber.

The characteristics for the fiber-optic cable systems that were studied are summarized in Table 1. The beam quality at the ends of the fibers is calculated to be a fourth of the product on the basis of the fiber diameter with full light output angle.

[Passage omitted]

The thermal lens produced in the laser rod by the pump radiationguides the equivalent laser resonator in the plane-plane resonator stability diagram to the concentric system via the confocal resonator. With a further increase in pump power, the resonator becomes unstable with an erratic drop in laser power. The attainment of unstable points can be identified by small inroads in the laser's power characteristics.

3. Processing Results

During the cutting and welding trials, the laser was outfitted with various fiber-optic laser cables. All of the trials were conducted with an optical processing system that reduces the image formed on the fiber end of the LLK's on a scale of 1:2. The distance from the work was 100 mm.

3.1. Welding

The welding tests were conducted on unalloyed mild steel (St37) and high-alloy steel (X5 CrNi 1810). The light was focused on the surface of the metal in all the tests. Cross-sections of the welding seams were made to determine the penetration depth. A processing gas to control the shielding of the plasma above the workpiece is not required for the radiation of the Nd:YAG laser.[2] [see References]

The welding speed for the LLK's that were used is shown in Illustration 3. The chart shows the linerar correlation of both quantities. At the maximum beam power that can be transmitted through fiber of any diameter because of the accompanying beam quality, the fastest processing speeds can be attained with the 600-µm fiber. A comparison of the LLK's at the same 1-kW beam power shows that faster welding speeds can be attained below a penetration depth of 2 mm with thinner fibers because of the higher power density in the focus range.

The shape of the fused area of a bead-on-plate weld is shown in Illustration 4. The slight widening of the upper bead is to be attributed to heat conduction and it disappears at higher welding speeds.

Illustration 5 shows the penetration depth versus the laser power for different welding speeds. The penetration depth increases at a nearly linear rate with the laser power. The falling-off of the curves at great penetration depths is attributable to the influence of the focus depth.

3.2. Cutting

The trials for this were conducted on high-alloy steel (X4 CrNi 1810) using industrial-grade pure oxygen. Fiber-optic laser cables with diameters of 1000 µm and 600 µm were used. The maximum cutting speed versus the laser power for different cutting thicknesses and the fiber-optic laser cables used are shown in Illustration 6. With a laser power of only 500 W, cutting speeds of from 8 m/min to 10 m/min can be attained.

The cutting tests on 2-mm-thick, unalloyed steel show that, with a laser power of only 500 W, quality cuts with roughness depths R_z of from 3 to 4 µm can be made at a cutting speed of 4 m/min.

4. Outlook

With the increase in mid-level laser power for YAG lasers in CW operation and the use of fiber-optic laser cables, noew ranges of industrial applications are being offered for solid state lasers. In connection with this, the wavelengths of solid state lasers offerseveral substantial advantages as compared with CO_2 lasers:

- Metals absorb shorter-wave radiation better. Because of this, the efficiency of this method is greater when cutting metals.

- Glass is transparent for shorter-wave Nd-radiation. Highly corrected kinds of optical glass are available for shaping the beam which are outstanding due to only small lens flaws and negligible absorption.

- Quartz fibers can be used to transmit the laser power far into the kW range. In the process, the power loss is 10 percent for [focal] lengths of up to 100 meters.

The existing application studies show that processing speeds of up to 10 m/min at mid-level power outputs of from 500 W to 1 kW can be attained when cutting or welding thin sheet metal about 2 mm thick. These speeds appear to be sufficient for robot-controlled 3-D processing.

5. Extended Abstract

A high-power CW solid state laser for industrial applications has been developed. A multirod design based on four laser rods placed in a common plane-plane resonator was used. Each laser crystal is pumped by two krypton arc lamps with up to 14 kW of electrical input power. A switching-mode power supply technology approaching 95 percent efficiency is used. The lamp current can be switched from the minimum to the maximum value in less than 1 ms. The pumping chambers contain double-elliptical, gold-plated reflectors. A maximum, continuous output power of 2150 W is achieved, corresponding to a total efficiency of 3.8 percent.

A fiber-optic beam delivery system has been developed. Depending on beam quality, fibers with core diameters of 1000 µm, 600 µm, and 400 µm were used to carry maximum powers of 2150 W, 1820 W, and 1150 W, respectively. A special fiber input coupling scheme was set up to obtain constant beam parameters at the workpiece over the whole range of laser output power.

Welding and cutting trials at different power levels and with different materials have been performed. Maximum speeds of up to 10 m/min can be obtained for welding and cutting of 1-mm steel. A surface roughness of the order of 5 µm can be easily achieved.

Acknowledgments

The studies and trials were supported in connection with a joint EUREKA project, EU-226, by the BMFT under aid appropriation number 13 EU 00690. We would like to at this point thank the BMFT and the project sponsor, VDI-TZ, for their support.

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FRG: Firms Using Microtechnology Surveyed

93WS0482A Landsberg PRODUKTION in German 15 Apr 93 p 4

[Article by G.K.: "Sensor Industry Is Pacesetter; Microsystems Technology Continues To Gain Ground"—first paragraph is PRODUKTION introduction]

[Text] Mainz—How and to what extent will microsystems technology be used in small and medium-sized companies? In which areas are there obstacles to the transfer of the technology and intoduction into the market? The committee of experts on microsystems technology of the AMA, an association for sensor technology, answered both of these questions in a survey conducted in its member firms.

That there is widespread interest in microsystems technology is undeniable since at least 73 of the 197 firms to which the questionnaire had been sent returned it—a better-than-average response for questionnaires of this sort. The trend toward microsystems technology was also apparent elsewhere. Since 66 percent of the products are still being produced with conventional precision technology during the current production program, the "leading products" situation has already changed: Sixty percent of the products of this category are already being produced with miniaturization techniques. Probably as much as over 90 percent of the products that have now been developed, which it is estimated will appear on the market in from one to two years, will be produced with miniaturization techniques. According to the association, as a result of this the sensor-producing industry "has assumed the role of a pacesetter in the transfer of microtechnology."

Broken down according to the different technologies, thin film technology plays the most important role. This technique is already employed for over 26 percent of the current production. Accounting for 21 percent, thick layer technology and micromechanics, accounting for about 18 percent, are also quite frequently represented among the currently available products, while laser technology comes to "only" 14 percent and anisotropic etching to 11 percent. This shows that especially the already relatively good, easier to manage, and simpler miniaturization technologies have penetrated the production processes of the small and medium-sized companies.

The spread of more complex basic technologies, like micromechanics and microoptics, or modern techniques to the three-dimensional design of microstructure products, on the other hand, has only just begun. But at the same time the market craves efficient design methods for complex microstructure products with greater freedom of form and design. As the results of the survey demonstrate, information on the application potential of new microproduction techniques that also meet firms' requirements (LIGA [lithography, electroforming, casting (in microelectronics)] techniques or laser microprocessing) is still scarce. This is why the sensor industry association in its study calls for joint plans between institutes and industrial partners which must advance the transfer of technology to industry "within the framework of the BMFT [Ministry for Research and Technology] program for the promotion of

microsystems technology and prove its marketrelevance with convincing examples of successful market applications." Another handicap: "The misgivings about production and investment costs expressed by many firms must be overcome with practical advisory activities in each case of concrete application."

Asked about their reasons for going into microsystems technology, four nearly equally important criteria took shape: Of the 73 participants in the survey, 38 cited improvement of the function determining parameters of their products, 36 the lowering of costs, and 35 do not want to miss the train with regard to international development. And 29 firms finally have high hopes of achieving product functions that are not possible with macrotechnical means.

Within the framework of the questionnaires, the market researchers became convinced that too many technological achievements are still individually controlled and the services of other firms and institutes too seldom taken advantage of. In connection with this, the small and medium-sized companies are muffing their chance to be able to better survive on the microsystems technology market in international competition through slimmer structuring of their production processes.

Three Materials Neck and Neck

There was a surprise with regard to the materials used for the production of microstructure products. Contrary to expectations, silicon, on which most of the research institutes concentrate, was not the predominantly used material. Instead, used almost as much as silicon (mentioned 42 times) are metallic (41 times) and ceramic (35 times) materials. Plastics too are playing an increasingly greater role and are today already used by 23 firms. In connection with this, the institutes of the sensor technology association have to put up with the accusation that their research efforts "do not meet the requirements of the transfer of microsystems technology to industry." This holds all the more true since many firms emphasized that it is precisely glass and ceramic materials that are important. So it is no wonder that the sensor technology associaiton insists: "Broadening of the material basis for microsystems technology must be accorded the necessary priority once again in ongoing aid programs."

The participants also criticized production equipment as an indispensable prerequisite to the transfer of technology to industry. More than 85 percent of the firms see a need for action in this area, especially as concerns production machines for the construction and communications technologies, as well as measuring, inspection, and testing systems.

German Firm Manufactures Special Fiber Optic Chips

MI1006145393 Coburg OPTOELEKTRONIK MAGAZIN in German Apr 93 p 17

[Text] The IOT (Integrated Optics Technology) Development Company of Waghaeusel-Kirrlach has now developed integrated optical chips made of special glass to readiness for series production. They are used as branching point components in glass fiber technology.

As in the microchip, which has electrical conductor tracks for electrons, fiber-optic waveguide tracks in integrated optics are marked out on the ultrapure glass substrate by a photolithographic process. The fiber-optic waveguide is produced in a subsequent ion exchange process. The integrated optical component is produced by connecting glass fibers to the chip and assembling the unit in a housing. The technology used makes for cost-effective mass production of compact components of long-term stability that also take up little space.

Branching point components, as developed for optical telecommunications, make it possible to distribute light signals from costly transmitting lasers to many receivers at low cost.

The company, established in 1987 by Schott of Mainz and Zeiss of Oberkochen, is anticipating a large demand for integrated optics branching point components in 1993.

This forecast is based on Deutsche Bundespost Telekom's decision to lay a foundation glass fiber network for about 1.2 million glass-fiber based subscriber stations in the new laender between 1993 and 1995.

Further information available from: IOT, Bruchsaler Strasse 22, D-6833 Waghaeusel-Kirrlach, Tel. 07254-92520, Fax 07254-925210.

UK: Cost-Efficient Video Image Sensing System Developed

BR1106123393 Chichester INTERNATIONAL TELECOMMUNICATIONS INTELLIGENCE in English 31 May 93 p 6

[Unattributed article: "VVL Announces New Video Image Sensing Technology"]

[Text] A Scottish start-up company, VLSI Vision Ltd (VVL) of Edinburgh, has come up with a novel video image sensing technology that promises significant cuts in the cost of video cameras for applications such as videotelephones.

By clever circuit design and integrated circuit layout, the devices can be built with standard CMOS [complementary metal-oxide semiconductor] semiconductor manufacturing processes. That means that a video camera image sensing array can be integrated on the same chip as image processing and compression logic. Demonstration systems made with the technology include what can only be described as a "video bug." This comprised an array of 256 x 256 pixels integrated with video processing circuits to provide a CCIR-standard video signal together with alarm response circuits. A miniature lens with a 90 degree field of view was bonded to the surface of the chips to make a self-contained sub-miniature camera measuring less than 1 cm square. When triggered by an alarm event, the chip would transmit a video sequence to a remote monitor.

Last week, the company launched a commercial version of the device built into a video camera measuring just 107

mm by 53 mm by 24 mm and known as the Imputer. The system is fully programmable so that as well as being used as a standalone camera, it can be adapted to more specialised imaging applications such as robot vision for industrial process control. The idea is that once a specialised algorithm has been developed and proven, it can be incorporated into a single chip device.

The Imputer unit will sell for 500 pounds, for single example, a price that its makers claim is one-sixth the price of comparable conventional cameras. If bought in quantities of 1,000 or more, the cost is reduced to just £180 per unit. In a customised single chip implementation, VVL claims costs could be as low as £10.

An engineering development kit, including the Imputer development software, tripod and lenses sells for £2,000.

MICROELECTRONICS

Germany: Darmstadt College of Technology Develops Microphone Chips

MI0406025893 Munich SUEDDEUTSCHE ZEITUNG in German 22 Apr 93 p 34

[Article by Bernd Schoene: "Sound from Silicon: Miniature Microphones Accommodated on a Chip"]

[Text] Very small microphones, manufactured using micromechanics techniques, are starting to replace conventional transmitters. These silicon microphones bring together the acoustic sensor and amplification electronics on a single chip, Gerhard M. Sessler of Darmstadt College of Technology told a conference of the Audio Engineering Society in Berlin recently. The first applications are likely to be hearing aids.

This new type of transmitter is not an individual component, but a small package on a microchip. By means of etching and targeted "contamination" with suitable substances, a pressure-sensitive zone is created, only a square millimeter in area and a thousandth of a millimeter thick.

Part of the microchip thus becomes a piezoelectric crystal whose principal property is that pressure variations, such as those caused by sound, produce changes in the voltage between the ends of the crystal.

The transmitter is insensitive to vibration, such as that caused by walking. This fact, together with its unprecedented compactness, makes the silicon microphone ideal for very small hearing aids that fit invisibly inside the auditory passage. Electret capacitor microphones, which have to date been the smallest sound transmitters, are at least twice as large.

Another decisive advantage of silicon microphones is that they can be cheaply mass produced, as the sensor and amplifier circuit can be manufactured as one piece and, consequently, in a single production process. Over a dozen microphone sensors can thus be produced on a silicon wafer and separated right at the end of the manufacturing cycle.

However, the direct conversion of a sound into an electrical signal is impractical for some applications, as data exchange along electrical cables is increasingly giving way to optical communications. Optical microphones that generate a direct light signal for optical fiber lines, bypassing the electronic stage, are therefore being developed. Their sound sensor is a membrane lit by a light diode: When an acoustic signal strikes the membrane, it modulates the light beam.

United Kingdom: Computing, Communications Integrated on Single Microchip

MI0806125693 Munich SUEDDEUTSCHE ZEITUNG in German 29 Apr 93 p 35

[Text] The British company Inmos has recently presented a new microchip in London. The remarkable feature of the T9000 transputer is that it consists of two processors. One handles the computing tasks and the other takes care of communications, thus representing a kind of telephone exchange: A transputer can be linked up to any number of others and communicate very effectively and rapidly with its counterparts. The T9000 can process up to 200 million computing instructions per second (MIPS), and is thus one of the fastest microchips around, says Parsytech, a company selling transputer-based computers in Germany. By way of comparison, the processors of the great Cray supercomputers achieve speeds of 250 MIPS, but they have to be water-cooled during operation and are very expensive. The T9000 costs $600 now, and will be offered at $100 when it goes into mass-production.

Germany: JESSI Develops Cluster System to Process Microchips

MI1406145493 Bonn TECHNOLOGIE-NACHRICHTEN MANAGEMENT-INFORMATIONEN in German 29 Apr 93 pp 8-9

[Text] The semiconductor silicon continues to form the basis of microelectronics. However, the future of data processing requires additional new semiconductor materials that will make optical signal processing (photonics) possible. In particular, the efficiency of data processing equipment could be significantly enhanced by the use of light within the blue spectral region, rather than the red light used to date. For example, the storage density of CD disks could be quadrupled by using blue laser diodes, and such semiconductors would also represent major progress in information technology, metrology, and even superconductor memory units. The Institute of Semiconductor Technology at the RWTH [Rhineland-Westphalia College of Technology] in Aachen (headed by Professor K. Heime and Dr. M. Heuken), in conjuction with other institutes in Aachen, Bremen, and Duisburg, is developing optoelectronic light sources, circuits, memories, and modulators. The Volkswagen Foundation is funding this research with 800,000 German marks [DM] under its photonics program.

The basic substances for these new materials are zinc sulfide and zinc selenide, which are applied to a gallium arsenide substrate, the crystalline structures being

retained. One interestingf aspect of these materials is that they frequently possess unique physical properties. The principal method being used by the Aachen researchers to produce them is epitaxial deposition of the desired layers by organometallic gas-phase epitaxy.

In the project funded by the Volkswagen Foundation, epitaxial layers, enriched by additional doping, will be produced with wide band gaps, and their structural, optical and electrical properties will be characterized and optimized. The technical problems that have to be solved to produce such heterostructures are immense, and intensive research is being carried out on them throughout the out the world. For example, to develop new optoelectronic components using quantum effects, the junction between two semiconductor layers must be atomically sharp. The layers must be less than 1 nm (0.000000001 m) thick, and new technologies must be developed for doping, i.e., the targeted addition of desired impurities—in this case, nitrogen and gallium—to modify their electrical properties. Very slight quantities, of the order of 1:10,000,000, are often sufficient. This research aims to achieve structures for modulators, electro-luminescence diodes, and lasers that can be used as photonic and optoelectronic components in the blue and ultraviolet spectral regions.

As it is particularly difficult not only to produce, but also to characterize these new semiconductor heterostructures with precision, other research teams are also involved. X-ray diffraction and Raman and infrared measurement carried out at the Aachen RWTH's Physics Institute I under Dr. J. Geuts and Dr. A. Woltok, are making major contributions to explaining the structural and electro-optical properties of layers. Professor J. Gutowski of Bremen University is investigating high-excitation and non-linear effects on the sets of layers produced in Aachen. These studies provide the basis for understanding and optimizing layers and optical circuits. A new process for characterizing the interfaces is under development at the Institute of Electrical Engineering Materials at Duisburg University, under Professor E. Kubalek, and is being tested on the new heterostructures.

Further information is available from Professor Klaus Heime, Institute of Semiconductor Engineering, Chair 1, RWTH Aachen, Sommerfeldstrasse 28, D-W 5100 Aachen. Tel. (0241) 80 77 45 or 77 46.

Germany: 'Service Center' for Advanced Actuators Opened in Saarland

MI1006144493 Stuttgart LASER UND OPTOELEKTRONIK in German Apr 93 pp 20, 21

[Text] In order to offer small and medium-sized enterprises greater opportunities for access to relevant research results and developments regarding new actuators in microsystems technology, the New Actuators with Microsystems and Signal Processing Concepts Service Center (D*ASS) began work at the start of 1993 at the University of Saarland.

The facility has been established as part of the department of process automation. It is part of a nationwide network of 25 service centers funded by the Federal Ministry of Research and Technology (BMFT) as part of its Microsystems Engineering funding program. In numerous companies, there are very few experts capable of evaluating the performance potential of new or unconventional actuators, which include those involving electrochemical and shape memory materials, micromechanical types, and piezoelectrical, magnetostrictive, and electrorheological actuators.

Moreover, the actuator manufacturers are not competitive in the long term if they offer actuators solely as isolated components, and are unable to incorporate them into application-related total concepts. The center has devised a broad spectrum of services, ranging from advisory discussions through feasibility studies and technology evaluations to the production of laboratory samples or working models, in close collaboration with its counterpart "New Regulation and Control Systems for Fluid Drives" service center at the Technical University of Magdeburg. The work done by D*ASS in Saarbruecken focuses on formulating general design rules and developing problem-oriented prototype solutions with advanced actuators, including power electronics and signal processing components.

At this year's Hannover Industrial Trade Fair, from 21 to 28 April 1993, D*ASS is presenting a selection of R&D results on the Saarland higher education establishments' joint stand in Hall 18, stand L11.

It will be demonstrating the performance of advanced actuators using exhibits from "active vibration attenuation and computer-controlled testing and measurement technology."

Further information available from D.J. Jendritza, D*ASS Service Center, University of the Saarland, Building 13, D-W-6600 Saarbruecken 11, Tel. 0681-302-4195, Fax 0681-302-2678

CERN, Scandinavia To Collaborate on LHC

93WS0480A Paris AFP SCIENCES in French 29 Apr 93 p 20

[Article: "Scandinavians To Participate in Development of LHCs Superconducting Magnets"]

[Text] Geneva—On 23 April, the Scandinavians signed an agreement to collaborate with the European Particle Physics Laboratory of the CERN [European Nuclear Research Center] in the development of superconducting magnets, one of the most important elements of the LHC [Large Hadron Collider].

This new proton-proton particle accelerator, whose construction is planned for 1995, is to be installed in the ring that houses the LEP [Large Electron-Proton Collider] at the Franco-Swiss border. The related research program involves all of Europe.

Germany: Local Planning Permission Withheld for New Research Reactor

MI0806124393 Munich SUEDDEUTSCHE ZEITUNG in German 29 Apr 93 p 37

[Article by Peter Kafka: "Controversy Over Research Reactor"]

[Text] The planning of the new Munich research reactor (FRM II) has entered a crucial stage with the opening of the regional planning process. The FRM II will replace the FRM I (the "Atomei"), which has been used successfully for 35 years as a neutron source, and will be built in its immediate vicinity on the site of the Munich Technical University (TU) in Garching. Most of the cost, more than 0.5 billion German marks [DM], will reportedly have to be paid by the Land of Bavaria. Researchers from the physics department and the university clinic, and company representatives from ABB and Siemens presented the nature and purpose of the planned neutron source in a press conference.

There are hardly any differences in opinion over the diverse potential uses of a more efficient neutron source in basic physics and solid-state research and in molecular biology. Neutrons are also a helpful tool in many borderline areas between research and application—such as detecting traces of chemicals, producing "uncontaminated" silicon as a semiconductor material, and "X-raying" (tomography) to discover cracks and faults in workpieces.

In view of the high concentration of research institutes, high-tech companies, and university clinics in the Munich area, the reactor planners are pleading for the Garching location to be retained. At the same time, criticism of the nuclear reactor is coming from the local population.

Several local authorities and institutions are insisting that, without the essential information about potential hazards, it is impossible to give the go-ahead to the location, i.e., vote in its favor in the regional planning process. At present, there is only a "draft" safety report, which leaves most of the questions about risks unanswered. The Environment Ministry is currently having the detailed safety report inspected by the Bavaria-Saxony Technical Monitoring Board (TUV). It is not expected to be made public for some months.

SUPERCONDUCTIVITY

Chinese Scholar, Swiss Scientists Jointly Develop World-Record-Tc Superconductor

93P60282A Shanghai JIEFANG RIBAO in Chinese 22 May 93 p 5

[Unattributed article: "Chinese, Swiss Scientists Jointly Develop New Superconducting Material"]

[Summary] Bern, 20 May (XINHUA wire report)—Chinese visiting scholar in Switzerland Guo Jiandong [6753 1696 2767] and Swiss scientists have jointly developed a new superconductor with a world-record critical temperature. Guo and the Swiss Federal Higher Polytechnic University's Institute of Solid-State Physics research group, led by Prof. Ao-te [phonetic], used barium, calcium, copper, and mercury raw materials, and in April this year developed a Hg-Ba-Cu-O superconductor—heated for 5 hours at 800°C—that has a measured critical temperature of 133.5 K (-140°C).

TELECOMMUNICATIONS

Germany: Telekom's Plans for Cooperation in West, East Europe

93WS0460A Heidelberg NET—NACHRICHTEN ELEKTRONIK + TELEMATIK in German Apr 93 pp 158-159

[Unattributed NET interview with Telekom's managing director for technical networks, Gerd Tenzer; date and place not given: "Basis for Progress"]

[Text] The German Federal Post Office Telekom is worried about its position in the competition between the major telecommunications enterprises. The narrow equity position, the pace of the political discussions about Postal Reform II and the privatization of Telekom, as well as Telekom's tremendous need for action in international markets, increase the time pressure on the young telecommunications company. Diplomate engineer Gerd Tenzer, managing director of technical networks for Telekom, answers our questions about the current situation.

[NET] The new minister for Posts and Telecommunications describes the Postal Reform II as the central theme of his work for the next few weeks and months. Do you have any requests for the "new regulator"? Which time frames would have to be adhered to in order at least to make the last "window" for Telekom for a successful start in the competition?

[Tenzer] Telekom started on 1 January 1990. But you are right; it inherited a few weaknesses as well, which must be eliminated as fast as possible. These weaknesses can primarily be seen in the low equity capital, in the hurdles that need to be overcome in internationalization and the obstacles of the public service law. In order to eliminate the weaknesses mentioned it is absolutely necessary to alter the existing legal form. Only by changing the present status will it be possible for Telekom to be successful in the long run. Best of all would be the legal form of a corporation.

But we regard the increased competition that may result from Postal Reform II as completely positive. It should be taken into account, however, that Telekom is saddled with a series of special obligations or burdens through political and legal directives. As an example of that may be mentioned here particularly the establishment of an efficient telecommunications infrastructure in the new laender. It is therefore of major benefit for Telekom to obtain predictable, regulative framework conditions that assure successful further development of telecommunications networks and services.

As regards a point in time for Postal Reform II, the beginning of 1994 is surely a date which would be desirable from my point of view.

[NET] You are also occupied with the vision of a "European telecommunications community." How should one conceive of that? Where are the boundaries for this community drawn? Where do the eastern European countries belong in this concept?

[Tenzer] The development of a "European telecommunications community" is in direct connection with the joining together of the countries of the European Community. In a situation where the realization of a European Union based on the still in part existing major economic and social differences in Europe is being viewed with skepticism by many citizens, telecommunications are of crucial importance. It is the fundamental means of communication of the economy and connects the peripheral fields with the economic centers. Beyond that, telecommunications stimulate communication between people, make it more personal and create an opportunity for making long distances appear very small.

For the east European countries they play an enormously important role in building a healthy and flourishing economy. The west European nations possess the necessary know-how and they are prepared to support these countries in establishing transmission networks. This applies particularly to Germany and to Telekom. Germany as a traffic center between Eastern Europe and the European telecommunications community is a declared goal for our enterprise. For this reason Telekom itself or through subsidiaries is already actively involved in building the telecommunications networks in Eastern Europe and in the CIS. For example, joint cooperation between us and the network operators in Bulgaria, Poland, Romania, the Czech Republic and Ukraine has been agreed on for the operation as well as further development of an International Network Management System (INMS). Telekom has also acquired a 19.5 percent share of Utel. Utel is a joint venture with AT&T and PTT Telecom Netherland with the goal of developing and establishing a teletransmission network with an international link to Ukraine. In Kazakhstan Telekom will start a joint venture with PTT Kazakhstan. By means of the ROMANTIS enterprise, Telekom is helping the CIS states build a VSAT network. And, to give a last example, Telekom is participating in the Trans-European-Line (TEL). TEL is a fiberoptics project which connects Frankfurt with Prague, Warsaw, Budapest and other east European cities. The partners in this project are the national network operators of the Czech Republic, the Slovak Republic, Poland, Hungary, Romania, Croatia and Ukraine.

[NET] Such an organization must have good connections. Which networks will bring the European Telecommunications Community together technically, which time frames are being set for this?

[Tenzer] We have already taken some steps to realize the European Telecommunications Community. Thus, in the field of narrow band communication we are actively pushing ahead with the introduction of Euro-ISDN. Telekom, together with France Telecom, BT and Italian SIP, has forced the introduction of ISDN according to uniform standards. The introduction of Euro-ISDN is being done right now in the Telekom network. By the end of this year, all ISDN transmission stations will be equipped with Euro-ISDN.

In the field of broadband communication as well we are very active on the European level. Together with France Telecom, BT, Spanish Telefonica and Italian STET, we came to an agreement in September last year to build a Europe-wide, digital transmission network with the name GEN. A meshed, service-independent transport network between the nodes of the network operators is to be provided based on fiberoptic connections. As early as this spring, services from 64 kbit/s to 2 Mbit/s can be offered Europe-wide. An expansion to 140 Mbit/s is planned.

Based on GEN, the Managed European Transmission Network (METRAN) will be established in a further expansion level. In METRAN, which is defined as a transport network that utilizes the efficiency of the Synchronous Digital Hierarchy and the Asynchronous Transfer Mode of the future European broadband ISDN, a flexible transmission network will be available after 1995 throughout Europe.

The next step of the European broadband network has also been started already. In November last year the five major network operators in Europe (BT, France Telecom, DBP Telekom, Telefonica and STET) agreed on the establishment of a Euro-ATM pilot project. The network is to be available by the end of 1994 for operation with pilot customers.

[NET] Communities cannot be realized without cooperation with partners. With whom and in what area does Telekom already cooperate today?

[Tenzer] In addition to the already mentioned cooperations, Telekom has many additional bilateral relations with other European network operators.

We are also cooperating, for example, in multilateral expert talks with the Japanese NTT, with BT and with Bellcore in the United States in the field of developing fiberoptics systems in local networks.

In the field of standardization, Telekom is actively participating with the European Standardization Institute ETSI, for example. In the field of research and development, it has, together with others, pressed for joint activities. Thus, we are cofounders of the European Institute for Research and Strategic Studies (EURESCOM) located in Heidelberg.

In the common development of services, Telekom has also established bilateral relations with other network operators. As an example of this may be mentioned the close cooperation with France Telecom. Our joint subsidiary EUCOM last year celebrated its fifth year of successful operation.

FRG: Investigation of HF Channels for Digital Cordless Telephones

93WS05088A Berlin NACHRICHTENTECHNIK-ELECTRONIK in German Feb 93 pp 66-70

[Article by Ulrich Kauschke (Deutsche Bundespost Telekom, Central Office for Cordless Telephony): "Investigations of Wide-Band HF channels for DECT"]

[Excerpt] ***The channel investigations herein described consist of preliminary measurement studies of the propagation and computer-based simulation of the radio telephony service observed in particular environments. An attempt is made to provide an extensive forecast of field strengths and bit error rates based on computer simulations so as to be able to evaluate the possible implementation of the observed radio technologies beforehand. Of particular interest is the DECT Standard, which represents a wide-band microwave telecommunications net and therefore a key technology of future, wide-band telecommunications services.***

Following are abbreviations used in this report:

BER - bit error rate; CAI - common air interface; CRC - cyclic redundancy code; CT - cordless telephony; DECT - digital European cordless telephony; ETSI - European Telecommunications Standards Institute; FDMA - frequency division multiple access; GSM - group special mobile; IR - impulse response; ISI - intersymbol interference; PNS - pseudo noise sequence; RSSI - received signal strength indication; TDD - time division duplex; TDMA -time division multiple access.

1. Mobile Communications Standards

The development of mobile communications represents a new technological advance. Besides conventional mobile radiotelephone service, which is carried out in the C- and D-nets, cordless telephone facilities are becoming increasingly more important.

While the D-mobile radiotelephone service net is already in operation, the CT2 is in the construction phase, and the cordless wide-band DECT technology is still under development.

The D-mobile radiotelephone service net (GSM) operates on a frequency of 890-915 MHz and 935-960 MHz; it has a bandwidth of 200 kHz; an FDD duplex; 8 channels or carriers; and a bit rate of 270.83 kbit/s. The cordless CT 2 CAI system operates on 864-868 Mhz; it has a band width of 100 kHz; a TDD duplex; 2 x 1 channels; and a bit rate of 72 kbit/s. The cordless DECT system operates on 1.88-1.9 GHz; it has a bandwidth of 1728 kHz; a TDD duplex; 2 x 12 channels; and a bit rate of 1152 kbit/s.

DECT Cordless Communications

Spontaneous speech and data transfer communications are gaining ever more importance in modern, mobile societies. Cordless telephones, such as, for example, described in DECT the standard [1], are more and more in demand both for private as well as for office use.

For future applications, the development of extensive mobile radiotelephone nets to service a large number of subscribers as well as the implementation of high gross bit transmission rates in the form of wide-band digital systems are desirable. The bandwidth B and channel capacity C are related to each other in a signal-to-noise ratio by means of the Shannon formula $C = B\log_2(1+S/N)$. Only wide-band systems show a high channel capacity [2].

Besides the GSM-Standard (D-nets) of cellular mobile radiophony, a rapidly moving user might also be offered a picocellular cordless system, which enjoys high capacities for cordless telephony "at home, in the office, and on the street" [3].

The DECT-Standard should meet these goals. It offers an overcapacity of channels in picocellular extensions (less than 200 m in cases of maximal 250 mW). The maximal transmitting power is +24 dBm, the required receiver power is -83 dBm. Capacities of 40,000 traffic volumes/ km^2 are aimed for. Because of undesirable interference and bit errors due to multipath propagation, the system is limited in range. Consequently, the low power and picocellular design is preferred in order to avoid interference and to lessen to effect of multipath propagation. Small, inexpensive, but perfectly adequate hand-held radiophones will be offered to customers throughout Europe and existing communications directives and standards (e.g., ISDN, PSTN, LAN, GSM) implemented on a cordless basis. Within the framework of an extensive multicell configuration both indoors as well as outdoors (typical public access, e.g., telepoint) will be implemented. Indoors the transmission losses are very pronounced, and multipath propagation can also occur. Thus, a cell size of about 70 m is planned for indoors, and cells for typical telepoint applications of 160-220 m for outdoors.

In the frequency range 1880-1900 MHz (GMSK modulation) everyone is supplied a hand-held, 10-HF-carrier phone having a bandwidth of 1728 kHz (frequency division multiple access - FDMA, selectable frequency access). Transmitted are 1152 kbit/s. Twenty-four time slots (time division multiple access - TDMA, selectable access to time slots) permit the establishment of 120 full duplex connections, of which 12 each are available for outgoing and return direction (time division duplex -TDD). Through the efficient use of FDMA/TDMA/TDD technology, the DECT Standard can offer 120 channels per base station. Because of the picocellular design of the system, the service area of one such base station is limited to a radius of less than 200 m. Unlike the cellular technology of the GSM Standard, the base stations exercise no central control of the available channels in DECT. Instead, the net organizes itself. Each hand phone recognizes the base stations within range and actualizes a list of possible channels in the particular time slot. The hand phone can independently switch over between channels and thereby establish the best available connection (seamless handover), which is possible both within a cell as well as at cell boundaries. The 416-µs-long data burst (480 bit) consists of an S-field (synchronization, 32 bit), followed by an A-field (header, control, and CRC-data, 64 bit), the B-field (320 bit data), the X- and Z-fields (indicators for 50 µs timeoff between

two time slots). 424 bit are transmitted in 367 μs. RSSI- and CRC-diversity are possible. The quality of a connection can be best tested by means of a CRC check.

3. Multipath Propagation in the DECT Radio Channel

3.1. Signal Propagation in Mobile Radiotelephony

The investigation of propagation conditions in a radio channel is of central importance in developing modern, efficient, digital radio systems. The following schemata generally obtains in intelligence technology: messages are generated in source (Q), which encoded (C) go to sender (S), and then transmitted in the radio channel. Finally, the signals are received by an antenna, decoded and/or demodulated (D) and directed to a sink (Se). There is a variety of interference in the radio channel as, for example, noise, attenuation, fading, multipath propagation.

The signal sent out in mobile radiotelephony reaches the receiver in several ways; the received power spectrum is stretched with respect to time, often referred to as the power delay spectrum. Besides the absolute travel time delay due to the distance between sender and receiver, another intermediate time extension of the power spectrum occurs because of multipath propagation, even individual echoes are probably resolvable. Signals from various paths become superimposed at the receiver. Owing to the superposition of the individual waves, whose phases change with the frequency, the transmission function of the radio channel becomes frequency-dependent. If only one propagation path exists, the transmission function is constant. Should a second propagation path occur, sudden changes can occur in the transmission function at frequency intervals corresponding to the reciprocal value of the travel time differences. Since, there are usually many propagation paths, these changes apparently occur irregularly, but often. Owing to the different travel distances, which are a high multiple of the wavelengths, the phases change by a high multiple of 2 π. Consequently, the channel is almost incalculable, and one must resort to statistical methods to characterize it. The different propagation times and the dependence of the transmission function on the frequency results in dispersion. In a narrow-band system, this dispersion leads to nonfrequency-selective fading; in a wide-band system, the transmission function is frequency-independent and the superposition of bits of various propagation paths leads to intersymbol interference (SI), resulting in an increased bit error rate (BER).

3.2. rms Delay Spread

A characteristic value for the multipath propagation is the rms delay spread averaged quadratically [exponentially to the 2nd power]. The time delay averaged over power is called the average time delay (designated by a "t" under a dash); the time delay averaged quadratically (second central moment) is called the rms delay spread (designated as σ_t equals the square root of averaged $t^2 - t^{-2}$).

It limits the bit transmission rate and/or the maximal permissible cell size, since a high bit transmission rate requires a large bandwidth. The product of bandwidth B and the maximal time extension of the power spectrum t_M (30 dB points) has to be much smaller than 1: B t_M1. $f_C = 1/t_M$ is the so-called channel coherence bandwidth. Channels are called narrow band when $B << 1/t_M$, in which case the radio channel is not frequency-selective [4]. In the case of an exponential delay power spectrum, $t_M = \ln 1000\ \sigma_t$. Large cells harbor the danger of the individual propagation paths having large propagation time differences and the increased danger of a high ISI. Unwanted, large transmission losses and rms delay spread differences between the various propagation paths at the cell boundaries causes the permissible bit error rate to be exceeded. In such cases, the hand instrument has to be switched to a new base station. By knowing the delay spreads in various propagation areas, it is possible to evaluate the cell size and consequently the number of base stations required. However, even in the immediate vicinity of a base station unfavorable multipath propagation can result in a high BER. Consequently, investigations of channel behavior, i.e., of the wave propagation in the mobile radiotelephony at a typical frequency is absolutely essential for wide-band systems like DECT.

As a rule, there is not a direct visible link to the sender. The signals arrive at the receiver along different paths and are may be bent, reflected, and shaded [shadow factor] along the way. Path differences are therefore considerably greater than the wavelengths, and the transmission properties are generally time-dependent as well. Consequently, one must resort to statistical analyses, made in typical areas, when forecasting field strengths.

When waves of like amplitude become superposed with a phase shift of 180°, extinction occurs at the receiver's location. Regardless of its location, therefore, sudden changes can occur in receiver performance. The individual propagation paths are vulnerable to fading and in narrow-band systems are described by the so-called Rayleigh distribution. The amount of the individual components is small vis a vis the total field strength; there are many scattering centers and the phases vary statistically. Since the probability of exceeding a particular reference level is defined by the Rayleigh distribution, the distribution is an important factor in planning narrow-band radio nets. For example, the variance of the statistical field strength in a narrow-band, Rayleigh-distributed channel is 5.57 dB. For Rayleigh distribution to exist, there can be no direct visible link to the sender. Otherwise the radio channel could, for example, be described by the so-called Rice distribution.

Since transmission paths change in the course of time (e.g., because of mobile receiver, sender, or reflecting objects), these loss processes are time-dependent and lead to time-dependent fading, a phenomenon known also from medium-wave radio operation. The time-dependent fading can be traced back physically to the Doppler shift, which results in a slight frequency shift in the HF carrier. When waves with somewhat different frequencies are superimposed, beat frequencies (i.e., amplitude changes slowly with time) may occur. In such cases, the total power may reveal sudden drops, which may reach several 10 dB, at specific time intervals. The coherence time is the reciprocal of the Doppler broadening B_d [4].

It is expected that the DECT HF-channel will show a slow time-dependent fading and clear frequency selectivity (dispersion): $B>>f_C$, $t_bB_d<<1$, where T_b is the bit period (0.868 μs in DECT).

3.3. Bit Error Rate

Radio net planning of narrow-band communications service is based on field strength forecasts. They are insufficient in wide-band systems however. The transmission of high bit rates requires that only small propagation time differences occur between the waves of a single propagation path. Otherwise the danger exists that the individual bits, owing to intersymbol interference (ISI), will be incorrectly interpreted at the receiver side.

In wide-band systems as, for example, in the DECT Standard, in addition to a field strength forecast, a precise statistical analysis of the propagation time differences has to be made under typical environmental conditions in order that a reliable scientific basis is obtained for the subsequent implementation of the Standard. The anticipated propagation time differences depend on the special environmental conditions. They are therefore naturally different for indoor and outdoor operations. While rms delay spread of 30-100 ns are expected indoors, delay spreads of 200-300 ns are possible outdoors [6, 7, 8]. It is expected that the bit error rates will climb quadradically with the delay spreads. Theoretical models already forecast that the permissible bit error rate of BER $< 10^{-3}$ for delay spreads will be surpassed by about 30 ns [9]. This same source [9] indicates that the error probability climbs quadratically with the delay spread.

Some measurements show that the climb in the bit error rate correlates only moderately with the rms delay spread, indicating that other factors must be involved. This also emphasized the need to investigate the channel transmission properties in special environments for the purpose of developing a precise classification of such environments in various indoor and outdoor categories. When the results of such a study are at hand, then it would be possible to evaluate with some certainty the feasibility of introducing the DECT system in the various environments and to ascertain the requisite technical accessories (e.g., antenna diversity) to improve transmission quality.

The occurrence of bit errors in the form of individual bursts is observed in Monte Carlo simulations [12]. The occurrence correlates with deep fadings of the general reception level, which arise as the result of time and frequency selectivity of the radio channel. Bit errors occur in large numbers causing entire time slots to be lost, while most remain undisturbed. When the step rate is 1 m/s, one of 275 time slots is lost (with a probability of more than 50 percent) when the bit error rate exceeds 10^{-3}. If the connection can be maintained, the speech quality can still be good despite the high BER.

3.4. CRC Error Rate

Instead of the BER, a study of the CRC data can be used to evaluate the connection, in which case an error smaller than 10^{-2} has to fall out. Adaptive antidistortion devices are not included in the DECT Standard. The first investigations show that to keep the CRC error rate under critical limits, the antenna diversity permits an increase of up to 217-450 ns in the rms delay spread in noise free environments (S/N = 60 dB) and of 100-150 ns in noisy environments (S/N = 20 dB) [7, 10]. 450 ns obtains for CRC diversity, S/N = 60 dB.

Reference [11] described a simulation in a two-path model with respect to the CRC error rate with and without antenna diversity in cases of different S/N values. The signal strengths received from two antennas are used for the evaluation in the case of RSSI diversity, and then the best time slot is selected. In cases of moderate S/N values of about 30 dB an excessively high error rate already occurs for rms delay spreads of 50 ns; at the high S/N = 60 dB the limit is reached for 100 ns. RSSI antenna diversity raises this limit for S/N = 30-60 dB to 175 ns. Since this value is already anticipated in typical telepoint outdoor environments [10], problems could arise with the implementation of DECt. CRC quality checks (CRC diversity) could help further since they provide quality characteristics even at high field strengths. CRC-controlled diversity is to be preferred to RSSI-controlled diversity, especially in problems involving multipath propagation. Assuming a very good connection without noise (infinite signal-noise ratio), and dispensing with CRC diversity, a limiting value of 120 ns is found, which is reached in 30 percent of all locales in the range of a telepoint environment. Within 70 m of a telepoint base station, transmission losses and time dispersion result in a fall-out probability of 40 percent. Antenna diversity is required in order to be able to use DECT in simple telepoint environments.

3.5. Channel Investigations Conducted by the Central Office for the Mobile Telephony

Department P3 of the Central Office for the Mobile Telephony, which is responsible for the implementation of the DECT Standard, conducts thorough channel investigations in frequency ranges of interest. The purpose of these investigations is to obtain information on propagation behavior in typically DECT environments. To this end, investigations are undertaken to ascertain the typical propagation time delays and rms delay spreads on the basis of multipath propagation as well as BER in different spatial environments. Another purpose of the studies is to estimate the required cell sizes as well as the possible, errorless transmission rates and/or bit error rates. The results obtained are to be converted into the form of computer simulations in accordance with a classification of typical DECT environments. By so doing, it should be possible to provide information on channel behavior in the special environments and to provide scientific support for the planning of a mobile radiotelephone net. The computer-based simulations of DECT senders and receivers, together with the measured transmission properties, should be useful in providing information on the bit error rates to be expected in special applications and in correlating them with other properties of the radio channel.

[passage omitted]

Channel Simulation and Radio Net Planning for the DECT System

This description of the typical properties of radio channels used for wide-band operations leads to the conclusion that, besides transmission losses, time dispersion (pulse broadening caused by multipath propagation) also plays an important role in radio net planning. It is immediately apparent that excessive transmission losses over particular distances preclude normal service. New base stations would have to be planned in such situations. In the description of wide-band systems it is also essential that, besides transmission losses, shadings that are not related to the distance but rather to the propagation time differences of the different propagation paths, occur. Consequently, so-called "hot spots" (i.e., locales which are characterized by unacceptably high BER even though there is sufficient transmission strength) could also occur near base stations. The forecasting of such locales—possibly in the immediate vicinity of a base station—is an essential task of channel investigations. While in narrow-band systems the two-dimensional representation of transmission strengths is sufficient on the map of the area to be serviced, and can even be optimized through an intelligent selection of the sender site, in the case of wide-band systems, on the other hand, considerable attention must be paid to the delay power spectra and the BER caused by them.

In channel simulation the sender and the receiver are realized at a work station through programming techniques, and the signal "emitted" in the characteristic channel is naturally simulated on the computer by means of propagation models. Comparison of received against emitted bits yields direct information on the BER and its manifestation. It is possible that regular time-distributed BER occur, or that entire time-limited time slots disappear while others remain unchanged ("burst-character" of the BER [12, 24]). Channel simulation offers the advantage that countermeasures can be tested directly on the computer. Antenna diversity, in which the signal level (RSSI diversity) or comparison of "control bits" (CRC diversity) may be used as control factors, is one possibility. (Adaptive antidistortion devices is not designed in the DECT Standard.) The particular importance of the planned channel simulations can easily be seen here. Besides forecasting the applicability of the DECT system in special environments and providing an indication of the service probability, channel simulations also make it possible to test appropriate countermeasures in the event of poor service.

Moreover, simulation of the direct and neighboring channel interference is also desirable in that it helps determine whether the algorithm to be realized at the work station can be extended to the interplay of several base stations, which can then be set up at various sites.

Finally, comparison of the simulated system with commercially available DECT hardware provides valuable information as to just how far the available systems correspond to the simulated behavior and the Standard. BER can also be caused by the technical construction of the equipment, e.g., in the encoder/decoder. In this way, the equipment's BER might turn out less satisfactory than would be expected on the basis of the channel properties. It is also possible that the equipment from different manufacturers differ in quality as well.

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France: Telecommunications Minister on Policy Plans

BR0806093993 Paris ELECTRONIQUE INTERNATIONAL HEBDO in French 20 May 93 p 7

[News conference by Gerard Longuet, French minister of industry, posts and telecommunications, and foreign trade, with unidentified reporters on 11 May; place not given: "Politicians and Industry Will Work Well Together"]

[Text]

[Reporter] In what way does the Ministry of Industry wish to get involved in defending industry?

[Longuet] In competitive economies, industry is still the primary driving force behind growth: In the past 10 years, industrial employment has grown in Japan and the United States and held steady in Germany. Unfortunately, it has declined in France by 25 percent (...). The result is that we have more than 3 million unemployed and a broken industrial base.

My present goal is simple:

—To reconstruct our industrial base;

—To create the conditions for new growth.

I can tell you that I have been exerting many efforts in this regard over the last month.

[Reporter] Will customs duties exist after the GATT negotiations?

[Longuet] We must not forget that Europe is the most open economic area in the world. As a region it must retain its economic solidarity and its solidarity in terms of lifestyle, culture, and society. It cannot be a simple free trade area open to the four corners of the world, unless it renounces its personality and social gains (...). In order to be in a strong position in international markets, our European companies must have a solid home base, a market from which they can develop and earn a return on their investments. Europe therefore must be capable of offering them an area of relative economic security. Furthermore, it is in the interest of countries belonging to specific regions—Asian countries or East European countries, for example—to start liberalizing their own internal market before asking us to open up our markets to their products.

[Reporter] Will the Ministry of Industry be interested in "work in the field"?

[Longuet] (...) I am convinced that my department, with close to 3,000 agents in the provinces, will be able to process the most sensitive and important industrial applications in a personal and efficient way (...). France is not so big that its minister of industry would not be able to take an interest in major industrial enterprises to which his attention is drawn.

[Reporter] Which companies will be privatized?

[Longuet] (...) I am responsible for 30 state-owned enterprises. These can be divided into two categories: those in a monopoly position and those operating in competitive markets. The second category, as the prime minister has announced, are to leave the government fold. As soon as the new privatization law has been adopted, they will be privatized (...).

I will pay special attention, in conjunction with my colleague responsible for the economy, to the constitution of the core shareholder base, which must be able to act as an industrial operator.

[Reporter] Will government support for Bull and SGS-Thomson be changed?

[Longuet] When I arrived at the ministry, I was faced with some difficult questions, which were the consequence of industrial policies that were too often based on excessive government intervention. These policies had not taken enough account of the market and international pressures. To take a few examples: Bull, first of all. It is hard to imagine that Bull can continue to accumulate losses for much longer (7 billion French francs [Fr] in 1990; Fr3.3 billion in 1991; Fr4.7 billion in 1992). It has cost taxpayers Fr15 billion in 10 years. A decision is all the more pressing since we are being watched by the European Commission. It absolutely is essential for Bull to define a new strategy by the summer, based on its fields of technical expertise and its European and American commercial base.

The second example is SGS-Thomson, the electronic components branch of the French [Thomson] group.

Components are a national priority which we must consolidate with the assistance of all those involved in the sector. Government action is justified here for two reasons:

—This industry is at the heart of new technologies and its market is not yet a global one. (The minister is implying here that many components require local production facilities (ASIC's [application-specific integrated circuits], etc.) in order to be able to efficiently meet the innovation requirements of the rest industry.) We cannot abandon it to an oligopoly which could easily close off access to the most sophisticated components, or ration our markets. Nevertheless, it is not a question

of setting up absurd industrial constructs, like the mixture of the components and nuclear sectors artificially decided by the previous government. (This is the written text given to journalists. At the news conference, Mr. Longuet simply declared that "the association of SGS-Thomson with CEA-Industrie was not to be a long-term partnership and that the latter would be replaced in part by an industrial company or an operator from the telecommunications sector.")

I will not accept the mutual impoverishment of these two sectors. I would add that this industrial construct is threatening the provisions made (by CEA-Industrie) for the dismantlement of the La Hague [nuclear power plant].

[Reporter] What is the ministry's policy with regard to television standards?

[Longuet] The policy which sought to impose D2-MAC [transitional analog high-definition television standard] has now reached an impasse (...).

Communications Minister Alain Carignon and I will ask Xavier Gouyou-Beauchamp [title not specified] to ponder about these new communications techniques. His proposals, which I will receive in July, hopefully will allow me to bring order to a question which is threatened with ending up in the graveyard of aborted French industrial projects.

[Reporter] What is the ministry going to do for telecommunications?

[Longuet] I have asked Marc Dandelot, state counselor, to study this sector's evolution. He will present me with his conclusions in July.

I also have expressed my desire to adapt the structure of France Telecom to competition in areas where competition already is the rule. This is why I have asked France Telecom to consider the creation of a subsidiary for its mobile phone services. I say the creation of a subsidiary rather than privatization, because these are two totally different things that people tend to mix up nowadays.

This issue seems all the more necessary to me since the main European telecommunications operators already have started or completed this phase (British Telecom in 1985; Deutsche Bundespost Telekom this year). It is not good management policy to mix the accounts of competitive activities with monopoly activities.

At the same time I will ensure that France Telecom's international position is strengthened. I hope that soon France Telecom and Deutsche Telecom will strengthen their ties, and that they will quickly add a North American partner.

AEROSPACE

Brazil: Stalled Joint Cbers Project With PRC Resumes

93SM0284X Sao Paulo VISAO in Portuguese 12 May 93 p 24

[Article by Julio Ottoboni: "Back to the Future"]

[Text] Stalled for the past two years owing to lack of funds, the joint China-Brazil program to develop an earth resources satellite (Cbers) has been picked up again by the Brazilian Government at an accelerated pace. At the latest meeting between the foreign ministries of the two countries, in March, agreement was reached on a new deadline for launching the Sino-Brazilian commercial satellite: October 1996. According to scientists at INPE (National Institute of Space Research) who are responsible for the Brazilian part of the program, this is a pretty tight time frame. The federal government, however, promises to release about $21 million in funding to see this phase through.

The 1993 Cbers budget of $13 million should probably be larger than the sum of the funds injected from the Brazilian side in the past four years. "President Itamar Franco agreed to a request by Minister Israel Vargas and will supplement the budget with proceeds from the privatization program," revealed INPE Director General Marcio Nogueira Barbosa. Included in the administration's support plans, another $8 million is supposed to be released to satisfy minimum funding needs to meet the new timetable. "We will still have difficulties, but the goal of 1996 had to be set in order to cut down the problems," reported Oscar Dias, the institute's space engineering manager.

Continual delays in transfers of appropriated funds have kept several parts of the project developed in Brazil from moving forward. Under the contract, components such as the structure of the satellite—considered critical within the process of developing the apparatus—will have to be produced "on the double" by Embraer [Brazilian Aeronautics Company], and delivered in less than two years. Work is proceeding on seven of the 12 contracts with suppliers. The rest will probably fall by the wayside because of the requirement to meet deadlines.

The truth is that the Chinese are unwilling to tolerate any further hesitation by Brazil. The first launch, scheduled for last year, did not take place because the Brazilians had invested less than $10 million. According to the initial contract signed in 1988, the total cost of the project is $150 million, of which 70 percent, or $105 million, was to be paid by China and the rest, $45 million, by Brazil. The solution was to reopen negotiations by paying off $2 million in debts to the Chinese government on the occasion of Rio-92, and to schedule new visits to INPE by Chinese scientists.

In the last two weeks of April, the Chinese experts were in Brazil for the second time this year. They confirmed that INPE's Tracking and Control Center will have a role in managing the satellites. "Everything has been agreed to, including the testing of the second model at our laboratories," Director Marcio Barbosa announced.

Warning

The transfer of the $45 million that is the responsibility of the Ministry of Science and Technology will be increased by $12 million because there is no land-based structure in Brazil to capture signals from the satellites. This warning comes from manager Oscar Dias, who insists there is no way to capture the signals unless such a land network is created.

The Sino-Brazilian satellites will be launched from the Shanxi base in China using rockets from the Long March series to place them in orbit 778 km above the earth. The satellite looks like a cube 2 meters long to which is attached a lateral mast holding three solar panels measuring 6 meters in all. Its useful life is three years, during which time it will be able to photograph the same point on the earth's surface every 12 days. The images will be able to record objects larger than 19 meters, and will be in color.

If the project with China becomes a reality, following the launch of the earth resources satellite, Brazil will be expanding its progress in the aerospace field. After all, besides the SCD1 already in orbit, four more satellites may be sent into space before the end of the decade. Such scientific progress will accredit Brazil as the first nation in Latin America to possess comprehensive space technology. It would also ensure a potential opening of commercial markets and Brazilian membership in the exclusive group of countries that are highly developed in this sector, such as the United States, Germany, Japan, Canada, Russia, Holland, and Sweden.

Brazil: Advantages of Alcantara Launch Center Seen

93SM0284Z Sao Paulo VISAO in Portuguese 12 May 93 pp 22, 23

[Text] It might seem excessive good fortune, but the cheapest place in the world for someone to launch a satellite into orbit is in Brazil. Experts estimate that within eight years this very site will be equipped to handle landings and take-offs of space shuttles—like the Discovery and Columbia—and launches of large rockets. The name of this base is the Alcantara Launch Center (CLA).

Planned by the Brazilian Commission for Space Activities starting in 1970, the Alcantara Launch Center offers advantages that, whether due to a lack of research or for geographical considerations, can be found nowhere else on the planet. Built on 240 sq km of land on the coast of Maranhao State, 22 km from the state capital of Sao Luis and protected by an extremely tight security system, the CLA permits flight operations that have a high degree of reliability because of the very stable temperatures in the region. However, it is more than a safe site featuring stable meteorological conditions and a paradisaical setting: Alcantara truly is an economic and technological trump card in several respects, a card handed to Brazil as a gift from Mother Nature. The reason is simple: because of its proximity to the equator, the base is endowed with the "catapult effect," a natural resource that facilitates lifting any apparatus into equatorial orbit, resulting in a 25 percent savings on fuel.

For example, a rocket that requires 2 tons of fuel to reach space from a launch site at Cape Canaveral in the United States would need only 1.5 tons if launched from Alcantara.

To express this advantage in terms of money, this past February Brazil spent $14 million to have the Americans put the SCD1, the first Brazilian-made data collection satellite, into orbit. The same operation would cost $11.5 million at Maranhao.

Delay

The Alcantara base is the principal key that can open the door to independence in aerospace technology for Brazil. The plans of the All-Brazilian Space Mission (MECB) can be summed up into four stages: the launch base, the satellites, the satellite launch vehicles, and the tracking and control facility. Once these phases have been completed, launching a Brazilian space shuttle, for example, would cease to be a utopian dream to become, even if it were to take decades, a step that might be compared to that taken by the American Neil Armstrong, who 24 years ago placed a marker from the earth on the moon. However, to conquer space completely autonomously and keep its membership in the exclusive space club, Brazil will have to complete the only stage that seems to be a tricky one: building the Satellite Launch Vehicle (VLS).

That stage, now three years behind schedule, could even further compromise the Brazilian Mission plans to place three more satellites in orbit by 1996 without direct assistance from foreign technology. These satellites are the SCD2, the SSR1, and the SSR2 (the latter two are for remote sensing). The first answer to the delays in the mission is related to a shortage of funds. From the time it was first designed in 1989, to the fourth phase of construction reached this past April with the launch of the VS-40—a sort of rocket used for experiments—the VLS has absorbed $280 million. To complete it by 1995 would take another $38 million, a sum there is no guarantee that the government will disburse. The greatest resistance to the success of the mission is tied, however, to a question of international politics that certainly has an economic connotation.

According to Tiago da Silva Ribeiro, director of the Aeronautics and Space Institute (IAE) [expansion as published], the agency responsible for developing the VLS, the Group of Seven (United States, Canada, Great Britain, Germany, Italy, France, and Japan) has been putting pressure on countries that are interested in achieving aerospace autonomy. A UN document entitled "Access to Outer Space Technology: Implications for International Security," a copy of which the IAE director has obtained, names Brazil as one of the countries that will probably encounter obstacles in rocket development and launching. The American press has published articles in which experts say they would not let the VLS be finished," Ribeiro charged. [quotation marks as published]

More optimistic, Colonel Carlos Ancilon, director of the Alcantara Launch Center, insists: "There is plenty of coordination among the CLA, the IAE, and the Ministry of Aeronautics, and this will permit success by 1995." He agrees, however, that Brazilian autonomy bothers its competitors. The fact remains that while the Americans go into space to tinker repeatedly with their satellites as if they were working on the family car, and the Japanese lay plans to build a city of 100,000 people on the moon in 2050, Brazil faces yet another challenge in asserting its creative spirit and showing that in terms of aerospace technology, it can be part of the First World.

[Box p 23]

The Catapult Effect

The source of the catapult effect is strictly geographical. The closer the base is to the equator the more positive this effect will be and, consequently, the greater the speed an apparatus will gain when launched into space. Translation: at sites close to the equator, the movement of the earth, which turns on its own axis, is slower and is prolonged by having to cover a circumference of 40,000 km. At an extreme point like Antarctica, the movement corresponds to zero degrees; there is no circumference because the extreme turns on itself as if it were a toy top. In practice, this means that a rocket launched from Alcantara or some spot very close to the equator achieves an initial speed of 1,300 km per hour. From Antarctica, for example, the tangential velocity is zero. This explains why Alcantara can perform the operation 25 percent more cheaply than Cape Canaveral, in the United States.

The Alcantara Launch Center, which is 2 degrees south of the equator, is the only site in the southern hemisphere that has the catapult effect. In Italy, this resource was being exploited at a small base that was later deactivated as obsolete and potentially unsafe. American and Japanese bases, among others, use the catapult effect, but do not exploit it to the same extent.

TELECOMMUNICATIONS

ANT to Supply Fiberoptic Waveguide Transmission Technology to Vietnam

MI1006145193 Coburg OPTOELEKTRONIK MAGAZIN in German Apr 93 p 19

[Text] Cokyvina, the Vietnamese postal administration's procurement company, has awarded a contract worth almost 8 million German marks [DM] to Public Switching Technology in Eschborn, a Bosch Telecom subsidiary, to supply and service its digital electronic automatic exchange system.

The contract covers equipment for 18,000 switching units for use in the Thuong Dinh and five other subscriber exchanges, thereby supplying the area southwest of Hanoi with digital subscriber stations. The contract also includes linking the exchanges themselves together, and connecting them to the existing network via glass fiber sections approximately 45 km long.

ANT Telecommunications in Backnang, another Bosch Telecom subsidiary, will supply this digital fiber-optic waveguide transmission technology. The contract also makes provision for Vietnamese telecommunications engineers to be trained to install, commission, and maintain the equipment on their own.

Further information available from: ANT Telecommunications, D-W-7150 Backnang, Tel. 07191-132051, Fax 07191-133223.

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